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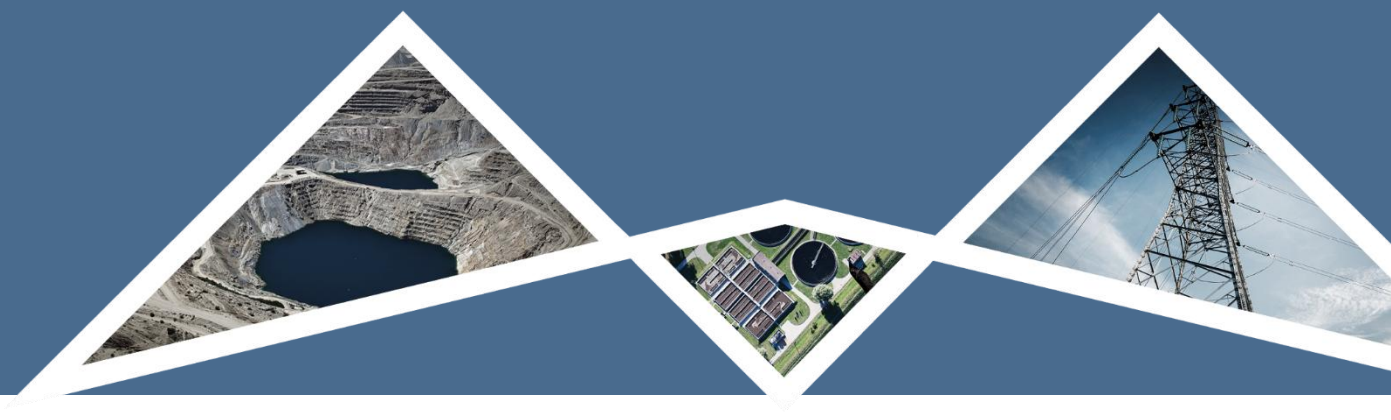
BASIC ASSESMENT REPORT

TETRA4 SEISMIC SURVEY

PASA REFERENCE: 12/4/007

MAY 2026



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Acronyms and Abbreviations

Acronym / Abbreviation	Meaning
AQ	Air Quality
BA	Basic Assessment
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
CQI	Chartered Quality Institute
DAFF	Department of Agriculture, Forestry and Fisheries
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EAPASA	Environmental Assessment Practitioners Association of South Africa
EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services (Pty) Ltd
EMPr	Environmental Management Programme
ESA	Ecological Support Area
FA	Fauna
FL	Flora
G	Geology / Palaeontology
GN	Government Notice
GNR	Government Notice Regulation
GW	Groundwater
I&AP / I&APs	Interested and Affected Party / Parties
IRCA	International Register of Certified Auditors
ISO	International Organization for Standardization

Acronym / Abbreviation	Meaning
km	kilometre(s)
LC	Least Concern
m	metre(s)
N	Noise
N/A	Not applicable
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFA	National Forest Act
NFEPA	National Freshwater Ecosystem Priority Areas
NT	Near Threatened
OHS	Occupational Health and Safety
PAOI	Project Area of Influence
PGS	PGS (Pty) Ltd
PPP	Public Participation Process
RQO / RQOs	Resource Quality Objective / Objectives
RU	Resource Unit
S	Social
SACNASP	South African Council for Natural Scientific Professions
SAMPI	South African Multidimensional Poverty Index
SAWS	South African Weather Service
SAHRIS	South African Heritage Resources Information System
SCC	Species of Conservation Concern
SEI	Site Ecological Importance
SSVR	Site Sensitivity Verification Report

Acronym / Abbreviation	Meaning
TMI	Total Magnetic Intensity
V	Visual / Landscape
VU	Vulnerable
W	Surface Water / Wetlands
WHO	World Health Organization
WGS84	World Geodetic System 1984

EXECUTIVE SUMMARY

This non-technical executive summary provides a high-level overview of this Environmental Basic Assessment Report (BA Report). The reader is urged to consult later sections of this report should more specific information or detail be required on various aspects.

PROJECT OVERVIEW

Tetra4 (Pty) Ltd (hereafter referred to as the applicant) has appointed Environmental Impact Management Services (EIMS) as the Environmental Assessment Practitioner (EAP) to assist with undertaking the necessary authorisation processes, including compiling the necessary reports and undertaking the statutory consultation processes, in support of the proposed project as described herein.

Following the successful commencement of Cluster 1 gas production in 2022, Tetra4 applied for relevant environmental approvals to expand the natural gas operations within the approved production right area and around the Cluster 1 project, designated as 'Cluster 2'. This Cluster 2 application area covered a total of ~27 500 hectares which overlaps with a large part of the Cluster 1 area.

The Cluster 2 Environmental Authorisation (EA) authorised various production well transects where drilling could occur with little to no specific drilling locations which resulted in some uncertainty from landowners. In order to mitigate this uncertainty and provide landowners with specific drilling locations, Tetra4 proposes undertaking a 3D seismic survey over the Cluster 2 area which would provide a high resolution subsurface geological profile and enable Tetra4 to visualise gas placement in the sub-surface and thereby enable more accurate identification of proposed drill sites on specific properties. The seismic survey will allow for high confidence identification of drilling locations and thereby also reducing the number of drilling locations as less dud/dry wells will be drilled which further reduces our environmental liability as well as provide landowners more certainty of location and number of targets

The process for a 3D seismic survey starts with creating a controlled sound wave or vibration at the surface, along the Source lines, as shown in the map in Figure 1 (green lines). This is often done using specialized vibroseis trucks that press a heavy plate onto the ground and vibrate it. The seismic survey within Cluster 2 will be executed using vibroseis source vehicles operating along parallel survey lines spaced 30 meters apart. These sound waves travel down through the layers of rock and sediment beneath the surface. As the sound waves hit the boundaries between different rock layers, some of the energy reflects. Highly sensitive sensors—called STRYDE Autonomous nodes —are spread out in a large, systematic grid pattern (the 3-D part) over the survey area to record these returning sound waves (the blue lines in the map below).

Tetra4 will be utilising a nodal system supplied by STRYDE (https://stryde.io/) , coupled with vibroseis acquisition by Polaris Natural Resources using five Nomad 65 units (https://www.polarisgeo.com/). The revised configuration comprises:

- STRYDE autonomous nodes (deployed at approximately 45–60 cm below surface, with no interconnecting cabling); and
- Five Nomad 65 vibroseis trucks.

The use of nodal technology materially reduces surface disturbance, as it eliminates all cable-related impacts associated with conventional geophone layouts. In addition, normal land use activities can continue during deployment, with the exception of soil disturbance activities such as ploughing. For context, the Nomad 65 units are standard mid-range vibroseis vehicles with the following approximate specifications:

- Length: ~10.6 m;
- Width: ~3.42 m;
- Height: ~3.2 m;
- Gross vehicle weight: ~31.7 tonnes; and

- Hold-down force: ~28.3 tonnes equivalent

While these are conventional seismic vehicles, their dimensions will necessitate limited temporary access in certain areas, primarily due to width constraints.

Finally, computers measure the exact time it takes for the sound wave to travel down, reflect off a layer, and return to all the different sensors. Since the sensors are arranged in a large grid, the computer can process the time measurements to create a detailed, three-dimensional model of the subsurface geology. This model shows the shape, depth, and type of underground rock formations, assisting in the location of helium and natural gas pockets.

The proposed project falls within the Masilonyana and Matjhabeng Local Municipalities, in the Lejweleputswa District Municipality, Free State Province. The site boundary is ~5km southwest of the town of Virginia, ~9km south the town of Welkom and ~16km north of the town of Theunissen. The application area covers approximately 27 500 hectares, and the approximate centre point of the site is located at 28°10'20.47"S and 26°43'50.79"E. A locality map is included herewith for ease of reference.

The National Environmental Management Act (NEMA) requires that the potential consequences or impacts on the environment of certain listed activities must be considered, investigated, assessed and reported on to the competent authority (in this case the Department of Mineral Resources). The planned seismic survey will trigger one of the listed activities and as such requires an Environmental Authorisation (EA) prior to commencing. The following specific listed activity is triggered by the proposed survey:

- Environmental Authorisation (EA) and amendments in accordance with the National Environmental Management Act- NEMA (Act 107 of 1998).
    - GNR 983 Listing Notice 1 Activity 21C: Any activity including the operation of that activity associated with an onshore seismic survey which requires an exploration right in terms of section 79 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice or in Listing Notice 3 of 2014, required to exercise the exploration right, excluding-
        (a) any desktop study,
        (b) any arial survey, and
        (c) a hydraulic fracturing activity which is included in activity 20A in Listing Notice 2 of 2014, in which case that activity applies.
    - GNR 983 Listing Notice 1 Activity 21D: Any activity including the operation of that activity which requires an amendment or variation to a right or permit in terms of section 102 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity contained in this Listing Notice or in Listing Notice 3 of 2014, required for such amendment.

The EIA process will be undertaken in accordance with the EIA Regulations (GNR 982) and will follow a Basic Assessment (BA) process.

NEED FOR PROJECT

The proposed project involves a 3D seismic survey within the approved Tetra4 Cluster 2 production right area in the Free State. The primary need for the project is to obtain high-resolution subsurface geological data to accurately identify natural gas and helium resources. This information is essential to reduce uncertainty associated with future drilling, thereby limiting unnecessary environmental disturbance, landowner disruption, and cumulative impacts.

From a strategic perspective, the project supports national energy security and economic development objectives. Natural gas is recognised as a transitional energy source that can reduce reliance on higher-emission fuels, while helium is a strategic resource of national and international importance. Although the seismic survey

itself is short-term, it forms a critical enabling step for potential long-term socio-economic benefits should viable resources be confirmed.

The project area includes environmentally sensitive features such as Critical Biodiversity Areas, Ecological Support Areas, wetlands, river systems, and endangered grassland ecosystems. These sensitivities have been comprehensively assessed through specialist studies. The assessment also encompasses areas characterised by significant modification, primarily resulting from intensive mining and agricultural activities. The seismic survey is non-invasive, temporary, and reversible, using surface vibroseis technology rather than drilling. Environmental risks are addressed through a strong precautionary and risk-averse approach, including avoidance of sensitive areas, application of buffers, timing of activities to avoid ecological and agricultural sensitivities, and immediate rehabilitation. With mitigation, residual environmental impacts are considered low.

Socio-economic impacts during the exploration phase are anticipated to be low and short-term, with limited disruption to agriculture due to careful scheduling. The project will provide temporary employment opportunities, local procurement, and skills exposure, with the potential for more substantial long-term economic benefits if future development proceeds.

Alternatives assessment confirmed that no feasible location alternatives exist due to the site-specific nature of the resource and legal boundaries of the production right. The preferred alternative—a flexible, micro-sited seismic layout using vibroseis technology—represents the best practicable environmental option when compared to the No-Go alternative, which could result in less efficient and potentially more invasive future exploration methods.

Overall, the project is considered needed and desirable, as it balances strategic resource development with environmental protection, social considerations, and the principles of sustainable development contained in the National Environmental Management Act. Subject to strict implementation of the recommended mitigation measures and EMPr, the project is environmentally acceptable and socially justifiable.

SPECIALIST STUDIES

A number of specialist studies have informed this application and environmental impact assessment and include:

- Palaeontology Study;
- Heritage Study;
- Terrestrial Biodiversity Study ; and
- Aquatic and Wetland Study

These studies assisted in identifying any Threatened Ecosystems, Sensitive and vulnerable ecosystems, Critical Biodiversity Areas, Ecological Support Systems, Conservation Targets and Ecological drivers of the ecosystem. Where sensitive species or ecosystem drivers were identified, relevant mitigation measures were put forward to prevent or minimise the impacts. To establish the baseline environment, this report incorporates data collected from both the current specialist assessments and previous specialist studies conducted for the Tetra4 Cluster 2 EIA within the same project area. The sensitivities assigned to the areas of interest are assigned based on the proposed activities, therefore the sensitivities identified and assessed in this BAR may differ to the sensitivities identified and assessed in the Cluster 2 EIA.

The proposed seismic survey is located within an area that includes geologically (palaeontologically), biologically, and culturally sensitive attributes, all of which have been assessed through specialist studies to inform impact management and mitigation. The key sensitive features assess by the various specialists are summarised below, further information can be found in the specialist reports (Appendix E):

Table 1: Summary of key sensitivity features assessed by specialists.

Specialist Assessment	Key Sensitivity features
Palaeontology	The proposed development area is partially underlain by the Balfour Formation of the Beaufort Group (Adelaide subgroup), a sequence of floodplain deposits globally significant for preserving the transition from early reptiles to mammals. Strategically, this area falls within the *Daptocephalus Assemblage Zone* (DAZ), which is further divided into the lower *Dicynodon–Theriognathus* and upper *Lystrosaurus maccaigi–Moschorhinus kitchingi* subzones. Given the Beaufort Group's international standing as the most complete fossil record of terrestrial vertebrate diversification, the presence of these strata indicates high palaeontological sensitivity. The SAHRIS PalaeoMap (red, Figure 4, Table 2) and the National Environmental Web-based Screening Tool (deep red, Figure 5) both classify the development area as having Very High Palaeontological Sensitivity.
Heritage	During the study, a total of 22 heritage sites and 28 features were identified. These consist of six historical homesteads; five metal objects; 12 recent structures, one ceramic surface scatter; and one grave.
Terrestrial	Degraded Grassland (No-Go): Confirmed or highly likely occurrence of Critical (CR), Endangered (EN), Vulnerable (VU) species that have a global Extent of Occurrence (EOO) of more than 10 km2. International Union for Conservation of Nature (IUCN) threatened species (CR, EN, VU) must be listed under any criterion other than A.
	Degraded Grassland: Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of more than 10 km2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A
	Disturbed Grassland: More than 50% of receptor contains natural habitat with potential to support Species of Conservation Concern (SCC)
	Transformed Land: No confirmed and highly unlikely populations of SCC. No natural habitat remaining.
	Water Resources: Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of more than 10 km2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A.
Wetland	Wetlands and a depression: The features are permanently to seasonally inundated wetlands with evident surface saturation and hydrophytic vegetation. While these wetlands occur within a modified landscape (historical agriculture and mining), they retain measurable wetland habitat and functional value
	Drainage Features:

Specialist Assessment	Key Sensitivity features
	features within agricultural fields and secondary grasslands are rated as having low sensitivity for freshwater biodiversity because their simplified structure, unstable flow, and poor water quality – often impacted by agricultural/mining runoff – provide limited habitat for aquatic life. These conditions support only a few tolerant species and contribute little to the conservation of freshwater biodiversity
	Artificial features: artificial features that provide limited/no ecological benefit to downstream watercourses. These features are predominantly fed by artificial sources such as mining activities and are therefore compromised in their water quality and ecological benefits. Therefore, a 'Low' sensitivity has been assigned to these areas in relation to freshwater biodiversity. Artificial mining-related infrastructure (e.g. pollution control dams/return water dams) with no remaining natural wetland habitat. These waterbodies are predominantly fed by artificial sources associated with mining activities, and water quality and ecological integrity are severely compromised, supporting only a limited suite of tolerant biota
	Remaining area The remaining area has been historically modified through agricultural and mining activities or other disturbances. The proposed activities are not anticipated to significantly modify the hydrological characteristics of the wetlands in proximity and in the local catchment; therefore a "Low" sensitivity has been assigned for these areas in relation to freshwater biodiversity.
Aquatics	The watercourses considered in this assessment represented characteristic source zone waterbodies with wetlands. Riparian vegetation was limited to features characteristic of wetlands. Given the wetland nature of the riparian vegetation, and relationships between wetland integrity within catchments and stable riverine conditions, the delineated wetlands were used to derive the sensitive habitats. Riparian zones within the lower foothills of the Doring and Sand River were well defined and comprised of woody species. The ecological sensitivity of the watercourses was determined to be largely uniform across the project area. Limited presence sensitive riverine biota was noted during the assessment, which is attributed to water quality and habitat degradation. Overall, the macroinvertebrate communities were made up of tolerant taxa with limited sensitivities. Taxa such as Atyidae (Freshwater shrimp), Hydropsychidae, Elmidae (Riffle beetles), and Ecnomidae (caddis fly) were determined to be the most sensitive aquatic invertebrates observed during the baseline assessment. Ichthyofauna communities were also found to be dominated by tolerant/adaptable taxa and largely consisted of cyprinids from the genera Enteromius sp., Labeo sp., and Labeobarbus sp. which are moderately intolerant to moderately tolerant to flow modifications, and moderately tolerant to modified to physico-chemical parameters. Given the assessments that have been conducted in the region, the above taxa are likely to occur only in isolated populations. Considering the presence of such taxa, the watercourses in the project area are regarded as sensitive environments in relation to changes in flow and water quality. The overall Ecological Importance and Sensitivity (EIS) of the river reaches in this study were and has been determined to have a rating of High.

PALAEONTOLOGY

The project area is underlain by Karoo Supergroup formations, which are known to be palaeontologically sensitive, particularly in relation to fossil-bearing sedimentary units. A specialist palaeontological assessment identified a high baseline sensitivity due to the regional fossil potential. However, the proposed seismic survey involves non-invasive, surface-based vibroseis technology, with no excavation or deep soil disturbance anticipated.

Potential impacts on palaeontological resources are therefore considered low, provided that ground disturbance remains minimal. A chance-find procedure is currently in effect and is based on the IFC standards, and will continue to be implemented should any palaeontological material be encountered during operations. With the application of this precautionary approach, the likelihood of permanent damage to palaeontological resources is considered negligible.

BIOLOGICAL ENVIRONMENT

The biological environment comprises a mosaic of transformed, degraded, and semi-natural habitats, as well as highly sensitive aquatic and riparian systems. The project area includes Critical Biodiversity Areas (CBA 1 and CBA 2), Ecological Support Areas (ESA), wetlands, rivers, and endangered Vaal-Vet Sandy Grassland. These ecosystems provide important ecological functions, including habitat provision, water regulation, and species connectivity.

Specialist biodiversity studies confirmed the presence or potential occurrence of Species of Conservation Concern, particularly within wetland, riparian, and grassland habitats. While much of the landscape has already been modified by agriculture and mining, watercourses and wetlands remain highly sensitive and are key ecological receptors.

The proposed seismic survey is inherently temporary, linear, and reversible. With mitigation measures such as:

- avoidance of sensitive habitats,
- application of buffers around wetlands and rivers,
- timing of activities to avoid sensitive breeding or migration periods, and
- immediate rehabilitation,

Residual impacts on flora, fauna, and ecosystems are expected to be low. No irreversible loss of biodiversity or ecosystem function is anticipated.

CULTURAL HERITAGE

The cultural heritage assessment identified a range of heritage resources, including archaeological material, historic structures, graves, and culturally significant sites. While the majority of identified heritage resources are of low to moderate significance, some features, such as graves, are regarded as highly sensitive and of high cultural value.

Given the non-invasive nature of the seismic survey, impacts on cultural heritage resources can largely be avoided through route planning and exclusion (“no-go”) areas. A heritage chance-find procedure is currently in effect and is based on the IFC standards requiring work to cease in the event that previously unknown heritage material is uncovered, with the relevant heritage authority notified.

Provided that recommended mitigation measures and access protocols are strictly followed, impacts on cultural heritage resources are expected to be low and manageable.

IMPACTS IDENTIFIED

A list of impacts that have been identified and assessed as well as the pre-mitigation environmental risk, post mitigation environmental risk and final significance when applying a priority factor is presented below.

Discipline	Impact	Phase	Pre-Mitigation Significance Score	Pre-Mitigation Significance	Post-mitigation Significance Score	Post-Mitigation Significance	Final score	Final Significance
Environmental	Dust generation	Planning	-5	Medium to low -	-2.5	Low -	-2.50	Low -
Environmental	Emissions	Operation	-8	Medium to low -	-6	Medium to low -	-6.00	Medium to low -
Environmental	Dust generation	Rehab and Closure	-5.25	Medium to low -	-3.5	Low -	-3.50	Low -
Terrestrial	Dust generation	Operation	-3.75	Low -	-2	Low -	-2.25	Low -
Heritage & Archaeology	Damage/destruction to known archaeological and heritage material	Construction	-14	High -	3.25	Low +	3.25	Low +
Graves	Damage/ destruction/disturbing of known graves	Construction	-20	High -	3	Low +	3.00	Low +
Environmental	Habitat degradation	Operation	-7	Medium to low -	-3	Low -	-3	Low -
Biodiversity & Habitat Loss	Indirect loss, disturbance and	Operation	-6	Medium to low -	-2	Low -	-2.25	Low -

Discipline	Impact	Phase	Pre-Mitigation Significance Score	Pre-Mitigation Significance	Post-mitigation Significance Score	Post-Mitigation Significance	Final score	Final Significance
	degradation of wetlands							
Water Resources & Drainage	Contamination of wetlands with hydrocarbons due to machinery leaks and eutrophication of wetland systems with human sewerage and other waste.	Operation	-6	Medium to low -	-3.5	Low -	-3.94	Low -
Biodiversity & Habitat Loss	Indirect loss, disturbance and increase in erosion and sedimentation to the receiving systems	Operation	-6	Medium to low -	-2	Low -	-2.25	Low -
Terrestrial	Vibration transmission to watercourse	Operation	-5.25	Medium to low -	-2.5	Low -	-2.81	Low -
Environmental	Displacement and increase in mortality of fauna	Operation	-6.75	Medium to low -	-6.75	Medium to low -	-6.75	Medium to low -

Discipline	Impact	Phase	Pre-Mitigation Significance Score	Pre-Mitigation Significance	Post-mitigation Significance Score	Post-Mitigation Significance	Final score	Final Significance
Biodiversity & Habitat Loss	Degradation of riparian vegetation and the introduction and spread of alien and invasive vegetation	Operation	-6	Medium to low -	-3.5	Low -	-3.94	Low -
Biodiversity & Habitat Loss	Degradation of wetland vegetation and the introduction and spread of alien and invasive vegetation	Operation	-6	Medium to low -	-3.5	Low -	-3.94	Low -
Terrestrial	Disturbance of riparian vegetation	Construction	-6	Medium to low -	-3	Low -	-3.75	Low -
Terrestrial	Introduction and spread of alien and invasive vegetation	Construction	-8.25	Medium to low -	-3	Low -	-3.75	Low -
Environmental	Soil Compaction	Planning	-7	Medium to low -	-3.5	Low -	-3.50	Low -

Discipline	Impact	Phase	Pre-Mitigation Significance Score	Pre-Mitigation Significance	Post-mitigation Significance Score	Post-Mitigation Significance	Final score	Final Significance
Environmental	Soil Contamination	Operation	-4.5	Medium to low -	-3	Low -	-3	Low -
Environmental	Soil Compaction	Rehab and Closure	-6	Medium to low -	-4	Low -	-4.00	Low -
Palaeontology	Loss of fossil Heritage	Construction	-16	High -	-5	Medium to low -	-6.25	Medium to low -
Terrestrial	Soil compaction and erosion near watercourses	Construction	-6.75	Medium to low -	-3	Low -	-3.75	Low -
Terrestrial	Increase in runoff/sediment transport of receiving systems	Construction	-8.25	Medium to low -	-3	Low -	-3.75	Low -
Terrestrial	Increase in erosion and sedimentation of receiving systems	Operation	-8.25	Medium to low -	-2	Low -	-2.50	Low -
Environmental	Groundwater Borehole Damage	Operation	-9	Medium to high -	-5.5	Medium to low -	-5.5	Medium to low -
Environmental	Groundwater contamination	Operation	-8.25	Medium to low -	-5	Medium to low -	-5	Medium to low -

Discipline	Impact	Phase	Pre-Mitigation Significance Score	Pre-Mitigation Significance	Post-mitigation Significance Score	Post-Mitigation Significance	Final score	Final Significance
Environmental	Noise from vibroseis base plates	Operation	-8	Medium to low -	-8	Medium to low -	-8.00	Medium to low -
Terrestrial	Noise disturbance to aquatic/riparian fauna	Operation	-3	Low -	-2	Low -	-2.25	Low -
Social	Security	Planning	-8	Medium to low -	-6	Medium to low -	-6.00	Medium to low -
Environmental	Security	Operation	-9	Medium to high -	-6.75	Medium to low -	-6.75	Medium to low -
Environmental	Agricultural activities	Operation	-12.5	Medium to high -	-5	Medium to low -	-5.00	Medium to low -
Social	Local Procurement	Operation	4.5	Low to medium +	4.5	Low to medium +	4.50	Medium to low +
Social	Landowner disruptions	Operation	-7	Medium to low -	-5.25	Medium to low -	-5.25	Medium to low -
Social	Security	Rehab and Closure	-9	Medium to high -	-6.75	Medium to low -	-6.75	Medium to low -
Social	Agricultural activities	Rehab and Closure	-8	Medium to low -	-4	Low -	-4.00	Low -
Environmental	Visual alteration	Operation	-3.5	Low -	-3.5	Low -	-3.50	Low -

Discipline	Impact	Phase	Pre-Mitigation Significance Score	Pre-Mitigation Significance	Post-mitigation Significance Score	Post-Mitigation Significance	Final score	Final Significance
Environmental	Hydrogeological alteration	Operation	-5	Medium to low -	-2.5	Low -	-2.50	Low -
Water Resources & Drainage	Impaired water quality due to accidental hydrocarbon spill	Operation	-6	Medium to low -	-3.5	Low -	-3.94	Low -
Terrestrial	Impaired water quality due to accidental hydrocarbon spill	Construction	-6.75	Medium to low -	-1.25	Low -	-1.56	Low -

PUBLIC PARTICIPATION

Stakeholder engagement for the proposed Tetra4 seismic survey was undertaken in accordance with the National Environmental Management Act (NEMA) and the EIA Regulations (GN R 982 of 2014, as amended). The objective of the process was to ensure that Interested and Affected Parties (I&APs) were identified, informed, and provided with meaningful opportunities to participate in the environmental assessment process.

An independent Environmental Assessment Practitioner (EAP), Environmental Impact Management Services (Pty) Ltd (EIMS), managed the Public Participation Process (PPP) to ensure transparency, inclusivity, and procedural fairness. The process sought to introduce the proposed project, explain the Basic Assessment process, identify and record issues and concerns, and ensure that stakeholder inputs were considered in project planning and impact mitigation.

A comprehensive I&AP database was compiled using landowner records, historical project information, Windeed searches, and stakeholder identification exercises. Stakeholders included affected landowners and occupiers, government departments, organs of state, municipalities, specialist interest groups, non-governmental organisations, and members of the public who registered during the process.

Stakeholders were notified through a range of communication methods to maximise accessibility and inclusivity. These included:

- Direct notifications via email, SMS, fax and registered mail;
- Newspaper advertisements and a Government Gazette notice;
- Placement of multilingual site notices within and around the study area; and
- Ongoing access to the EAP for queries and registrations.

All notifications and engagement materials were provided in English, Afrikaans, and Sesotho to ensure broad accessibility. The PPP commenced with an initial call to register and will include the availability of the Basic Assessment Report for a statutory public review and comment period, with both electronic and hard-copy access to the documentation.

Comments and issues raised by I&APs to date relate primarily to land access, requests for additional project information, coordination with overlapping rights holders, and procedural compliance. No fatal flaws were identified through the PPP. All comments received have been recorded and incorporated into the assessment process where relevant, with detailed responses provided in the Comments and Responses Report.

Overall, the stakeholder engagement process is considered adequate, compliant, and effective, providing stakeholders with reasonable opportunity to participate and ensuring that their concerns inform project design, mitigation measures, and decision-making. The process supports the principles of participatory governance, transparency, and environmental justice as required by NEMA.

IMPACT STATEMENT

The findings of the assessment and associated specialist studies conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding, provided that the recommended mitigation and management measures are implemented. Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the exploration activities, the findings of the specialist studies, and the understanding of the significance level of potential environmental impacts, it is the opinion of the BA project team and the EAP that the significance levels of the majority of identified negative impacts can generally be reduced to an acceptable level by implementing the recommended mitigation measures and the project should be authorised.

All identified impacts are expected to have low or moderate to low significance after mitigation is applied.

1 INTRODUCTION

Following the successful commencement of Cluster 1 gas production in 2022, Tetra4 applied for relevant environmental approvals to expand the natural gas operations within the approved production right area and around the Cluster 1 project, designated as 'Cluster 2'. This Cluster 2 application area covered a total of ~27 500 hectares which overlaps with a large part of the Cluster 1 area.

Tetra4 (Pty) Ltd (hereafter referred to as the applicant) has appointed Environmental Impact Management Services (EIMS) as the Environmental Assessment Practitioner (EAP) to assist with undertaking the necessary authorisation processes, including compiling the necessary reports and undertaking the statutory consultation processes, in support of the proposed project as described herein.

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The process for a 3D seismic survey starts with creating a controlled sound wave or vibration at the surface, along the Source lines, as shown in the map below (green lines). This is often done using specialized vibroseis trucks that press a heavy plate onto the ground and vibrate it. The seismic survey within Cluster 2 will be executed using vibroseis source vehicles operating along parallel survey lines spaced 30 meters apart. These sound waves travel down through the layers of rock and sediment beneath the surface. As the sound waves hit the boundaries between different rock layers, some of the energy reflects. Highly sensitive sensors—called geophones —are spread out in a large, systematic grid pattern (the 3-D part) over the survey area to record these returning sound waves (the blue lines in the map below). Finally, computers measure the exact time it takes for the sound wave to travel down, reflect off a layer, and return to all the different sensors. Since the sensors are arranged in a large grid, the computer can process the time measurements to create a detailed, three-dimensional model of the subsurface geology. This model shows the shape, depth, and type of underground rock formations, assisting in the location of helium and natural gas pockets.

The proposed project falls within the Masilonyana and Matjhabeng Local Municipalities, in the Lejweleputswa District Municipality, Free State Province. The site boundary is ~5km southwest of the town of Virginia, ~9km south the town of Welkom and ~16km north of the town of Theunissen. The application area covers approximately 27 500 hectares, and the approximate centre point of the site is located at 28°10'20.47"S and 26°43'50.79"E. A locality map is included herewith for ease of reference.

The National Environmental Management Act (NEMA) requires that the potential consequences or impacts on the environment of certain listed activities must be considered, investigated, assessed and reported on to the competent authority (in this case the Department of Mineral Resources). The planned seismic survey will trigger one of the listed activities and as such requires an Environmental Authorisation (EA) prior to commencing. The following specific listed activity is triggered by the proposed survey:

- Environmental Authorisation (EA) and amendments in accordance with the National Environmental Management Act- NEMA (Act 107 of 1998).
    - GNR 983 Listing Notice 1 Activity 21C: Any activity including the operation of that activity associated with an onshore seismic survey which requires an exploration right in terms of section 79 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice or in Listing Notice 3 of 2014, required to exercise the exploration right, excluding-

        (d) any desktop study,

        (e) any arial survey, and

(f) a hydraulic fracturing activity which is included in activity 20A in Listing Notice 2 of 2014, in which case that activity applies.

- GNR 983 Listing Notice 1 Activity 21D: Any activity including the operation of that activity which requires an amendment or variation to a right or permit in terms of section 102 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity contained in this Listing Notice or in Listing Notice 3 of 2014, required for such amendment.

The EIA process will be undertaken in accordance with the EIA Regulations (GNR 982) and will follow a Basic Assessment (BA) process.

1.1 REPORT STRUCTURE

Table 2: Report structure as per GN R 982.

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 1: Section 3(1)(a)	Details of – The Environmental Assessment Practitioner (EAP) who prepared the report; and The expertise of the EAP, including a curriculum vitae;	Section 1.2
Appendix 1: Section 3 (1)(b)	The location of the activity. Including – The 21-digit Surveyor General code of each cadastral land parcel; Where available, the physical address and farm name; Where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	Section 2
Appendix 1: Section 3 (1)(c)	A plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is – A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or On a land where the property has not been defined, the coordinates within which the activity is to be undertaken;	Section 2
Appendix 1: Section 3(1)(d)	A description of the scope of the proposed activity, including – All listed and specified activities triggered and being applied for; and A description of the associated structures and infrastructure related to the development;	Section 3
Appendix 1: Section 3 (1)(e)	A description of the policy and legislative context within which the development is proposed including- An identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks, and instruments that are applicable to this activity and have been considered in the preparation of the report; and	Section 4

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
	How the proposed activity complies with and responds to the legislation and policy context, plans, guidelines, tools frameworks, and instruments	
Appendix 1: Section 3 (1)(f)	A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;	Section 5
Appendix 1: Section 3 (1)(g)	A motivation for the preferred site, activity and technology alternative	Section 6.8
Appendix 1: Section 3 (1)(h)	A full description of the process followed to reach the proposed preferred alternative within the site, including: – Details of the development footprint alternatives considered; Details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them; The environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; The impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts – Can be reversed; May cause irreplaceable loss or resources; and Can be avoided, managed or mitigated; The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives; Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; The possible mitigation measures that could be applied and level of residual risk; The outcome of the site selection matrix;	Section 6 Section 7 Section 8 Section 9 Section 10

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
	If no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and; A concluding statement indicating the preferred alternatives, including preferred location of the activity.	
Appendix 1: Section 31)(i)	A full description of the process undertaken to identify, assess and rank the impacts the activity will impose on the preferred location through the life of the activity, including – A description of all environmental issues and risks that were identified during the environmental impact assessment process; and An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	Section 9
Appendix 1: Section 3 (1)(j)	An assessment of each identified potentially significant impact and risk, including – Cumulative impacts; The nature, significance and consequences of the impact and risk; The extent and duration of the impact and risk; The probability of the impact and risk occurring; The degree to which the impact and risk can be reversed; The degree to which the impact and risk may cause irreplaceable loss of resources; and The degree to which the impact and risk can be mitigated;	Appendix F
Appendix 1: Section 3 (1)(k)	Where applicable, a summary of the findings and impact management measures identified in any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report;	Section 9.3 Section 10.1
Appendix 1: Section 3 (1)(l)	An environmental impact statement which contains – A summary of the key findings of the environmental impact assessment;	Section 10.4 Section 10.2 Section 10.3

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
	A map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicting any areas that should be avoided, including buffers; and A summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	
Appendix 1: Section 3 (1)(m)	Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr;	Section 10.5
Appendix 1: Section 3 (1)(n)	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	Section 10
Appendix 1: Section 3 (1)(o)	A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	Section 11
Appendix 1: Section 3 (1)(p)	A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	Section 10
Appendix 1: Section 3 (1)(q)	Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised;	N/A
Appendix 1: Section 3 (1)(r)	An undertaking under oath or affirmation by the EAP in relation to – The correctness of the information provided in the reports; The inclusion of comments and inputs from stakeholders and interested and affected parties; The inclusion of inputs and recommendations from the specialist reports where relevant; and Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	Section 12
Appendix 1: Section 3 (1)(t)	*[Para. (t) substituted by GN 326/2017 and deleted by GN 517/2021]*	N/A
Appendix 1: Section 3 (1)(u)	Any other matters required in terms of section 24(4)(a) and (b) of the Act.	N/A - no further matters to those

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
		already listed above and included in this report.

1.2 DETAILS OF THE EAP

Environmental Impact Management Services (Pty) Ltd (EIMS) has been appointed by Tetra4 to assist in preparing and submitting the relevant environmental applications, associated reports and documentation, and to undertake a Public Participation Process (PPP) in support of the proposed Seismics Study project. In terms of Regulation 13 of the EIA Regulations (GN R. 982) as amended, an independent Environmental Assessment Practitioner (EAP), must be appointed by the applicant to manage the application. EIMS and the compiler of this report are compliant with the definition of an EAP as defined in Regulations 1 and 13 of the EIA Regulations, as well as Section 1 of the NEMA. This includes, inter alia, the requirement that EIMS:

- Is objective and independent;
- Has expertise in conducting EIAs;
- Complies with the NEMA, the environmental regulations and all other applicable legislation;
- Considers all relevant factors relating to the application; and
- Provides full disclosure to the applicant and the relevant environmental authority.

The details of the EAPs involved in the application and assessments are as follows:

Table 3: EAP/s Details.

Practitioners	John von Mayer (Senior EAP and reviewer)	Jessica Jordaan (EAP)
Tel No:	+27 789 7170	+27 789 7170
Fax No.	+27 86 571 9047	+27 86 571 9047
E-mail	john@eims.co.za	jessica@eims.co.za
Professional Registrations	SACNASP – Professional Sci. Nat (Soil Science), 400336/11. EAPASA – Registered EAP, 2019/1247.	SACNASP – Candidate Sci. Nat (Soil Science), 124758. EAPASA – Candidate EAP, 2023/7087.

1.2.1 EXPERTISE OF THE EAP/S

Mr John von Mayer is a senior consultant at EIMS and has been involved in numerous significant projects the past 17 years. He has experience in Project Management, small to large scale Environmental Impact Assessments, Environmental Auditing, Water Use Licensing, and Public Participation. He is a Registered Professional Natural Scientist (400336/11) with the South African Council Natural and Scientific Professions (SACNASP) as well as a registered EAPASA Environmental Practitioner (2019/1247) His key experience includes:

- Experience with identification and assessment of environmental impacts.
- Experience in environmental compliance and monitoring.
- Knowledge of environmental legislation and policies, planning process and regulatory frameworks.
- Knowledge and experience of public participation process.
- Strong competencies in the assessment of renewable energy and mining projects.
- Project management.

Mr von Mayer has been assisted by Ms. Jordaan is an Environmental Consultant and Candidate Soil/Agriculture Specialist at EIMS and has been involved in numerous environmental audits, prospecting and exploration rights environmental authorisation application projects, and rehabilitation projects regarding Financial Provisions. She holds a BSc degree in Geology and a BSc Honours degree in Environmental Soil and Soil Science. Ms Jordaan's experience includes managing and/or undertaking Environmental Impact Assessments (EIA) and Basic Assessments (BA), Soil and Agriculture Assessments, Financial Provisioning, Environmental Audits, and ISO14001:2015 Audits. Ms Jordaan is a registered Candidate Soil Scientist (#124758) with the South African Council of Natural and Scientific Professions (SACNASP), as well as a registered Candidate Environmental Assessment Practitioner (2023/7087) with the Environmental Assessment Practitioners Association of South Africa (EAPASA). She is a registered ISO 14001:2015 Lead Auditor with the Chartered Quality Institute (CQI) and a member of the International Register of Certified Auditors (IRCA).

1.3 SPECIALIST CONSULTANTS

Specialist studies have been undertaken to address the key impacts that require further investigation. Table 4 gives an overview of the specialist studies undertaken as part of this assessment.

Table 4: Overview of specialist consultants and assessments.

Assessment Report	Environmental Sensitivity Themes	Specialist
The Aquatic Biodiversity Compliance Statement	Aquatic biodiversity.	The Biodiversity Company (Pty) Ltd
Terrestrial Biodiversity Assessment	Animal species; Plant species; and Terrestrial Biodiversity.	The Biodiversity Company (Pty) Ltd
Archaeological and Cultural Heritage Assessment Report	Archaeology; and Heritage.	PGS (Pty) Ltd
Palaeontology Assessment Report	Palaeontology.	PGS (Pty) Ltd

2 PROJECT AREA

The proposed seismic survey is situated near Welkom in the Free State Province. The total survey area encompasses approximately 27 500 ha, extending across more than 280 farms and farm portions. Table 5 provides a detailed breakdown of the project area. Figure 1 provides a locality map of the proposed project area.

The predominant land cover within the project area consists of natural grasslands, mining infrastructure, and agricultural land (comprising centre-pivot irrigation, dryland/rainfed crops, and non-pivot irrigated cultivation), as can be seen in Figure 2. To a lesser extent, sparse forest, thickets, and woodlands are also present. The natural grasslands are primarily distributed alongside the main river systems and watercourses. Preliminary estimations indicate that transformed land—driven predominantly by agricultural and mining activities—accounts for approximately 70% of the Phase 2 project area. The remaining 30% comprises untransformed natural habitats, encompassing the grasslands, sparse forests, thickets, and woodlands.

Table 5: Project area information.

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Project Area</td><td>The proposed project area is located near the town Welkom in the Free State Province, South Africa.</td></tr>
<tr><td>Application Area</td><td>The project area encompasses a total of ~27 500 Ha.</td></tr>
<tr><td>Magisterial District and Sub Districts</td><td>Lejweleputswa Magisterial District:
Welkom Main Seat;
Masilonyana Sub District; and
Virginia Sub District</td></tr>
<tr><td>District Municipality</td><td>Lejweleputswa District Municipality</td></tr>
<tr><td>Local Municipalities</td><td>Matjhabeng Local Municipality
Masilonyana local Municipality</td></tr>
<tr><td>Farm Name, Number and Portion, including the 21-digit Surveyor General Code</td><td>
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<tr><td>Adamsons Vley 655 (Portion 2)</td><td>F03500000000065500002</td></tr>
<tr><td>Annex 3 No 478 (Portion 0)</td><td>F03300000000047800000</td></tr>
<tr><td>Annex Glen Ross 562 (Portion 0)</td><td>F03300000000056200000</td></tr>
<tr><td>Annex Glen Ross 562 (Portion 1)</td><td>F03300000000056200001</td></tr>
<tr><td>Annex Glen Ross 562 (Portion 10)</td><td>F03300000000056200010</td></tr>
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<tr><td>Annex Glen Ross 562 (Portion 3)</td><td>F03300000000056200003</td></tr>
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	Annex Glen Ross 562 (Portion 6)	F03300000000056200006
	Annex Glen Ross 562 (Portion 7)	F03300000000056200007
	Annex Glen Ross 562 (Portion 8)	F03300000000056200008
	Annex Glen Ross 562 (Portion 9)	F03300000000056200009
	Annex Grusde 474 (Portion 0)	F03300000000047400000
	Annex Mooivlakte 208 (Portion 0)	F03300000000020800000
	Annex Welgelegen No 76 (Portion 0)	F03300000000007600000
	Bethel No 96 (Portion 0)	F03300000000009600000
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	Bloemhoek 509 (Portion 8)	F03300000000050900008
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	Boschluis Spruit 278 (Portion 0)	F03300000000027800000
	Boschluis Spruit 278 (Portion 1)	F03300000000027800001
	Boschluis Spruit 278 (Portion 2)	F03300000000027800002
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	Braklaagte 41 (Portion 1)	F03300000000004100001
	Brakspruit 121 (Portion 0)	F03300000000012100000
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	Commericia No 430 (Portion 0)	F03300000000043000000
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	Dankbaarheid 16 (Portion 0)	F03300000000001600000
	Dayton No 560 (Portion 0)	F03300000000056000000
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	Doorn River 330 (Portion 12)	F03300000000033000012
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	Fairview No 532 (Portion 0)	F03300000000053200000
	Farm Annex 2 30 (Portion 0)	F03300000000003000000
	Farm Blijdschap 17 (Portion 0)	F03300000000001700000
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	Klein Pan 320 (Portion 0)	F03300000000032000000
	Kleinbegin 134 (Portion 0)	F03300000000013400000
	Kovno 235 (Portion 0)	F03300000000023500000
	Langlaagte 110 (Portion 1)	F03300000000011000001
	Langlaagte 110 (Portion 2)	F03300000000011000002

Item	Description	
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	Leeuwbult 52 (Portion 0)	F03300000000005200000
	Leeuwbult 52 (Portion 3)	F03300000000005200003
	Leeuwbult 580 (Portion 0)	F03300000000058000000
	Leeuwfontein No 256 (Portion 0)	F03300000000025600000
	Leeuwvlei No 115 (Portion 0)	F03300000000011500000
	Leeuwvlei No 115 (Portion 1)	F03300000000011500001
	Lekkerlewe 643 (Portion 0)	F03300000000064300000
	Leliesdal No 242 (Portion 0)	F03300000000024200000
	Metz No 295 (Portion 4)	F03300000000029500004
	Middelplaas 583 (Portion 0)	F03300000000058300000
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	Mond Van Doornrivier 38 (Portion 0)	F03300000000003800000
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	Mooifontein 639 (Portion 0)	F03300000000063900000
	Mooifontein No 158 (Portion 0)	F03300000000015800000
	Mooifontein No 158 (Portion 1)	F03300000000015800001
	Mooifontein No 158 (Portion 2)	F03300000000015800002
	Mooifontein No 158 (Portion 3)	F03300000000015800003
	Mooifontein No 158 (Portion 5)	F03300000000015800005
	Mooivlakte 199 (Portion 0)	F03300000000019900000
	Mooivlakte 199 (Portion 1)	F03300000000019900001
	Mooivlakte 199 (Portion 3)	F03300000000019900003
	Mooivlei 357 (Portion 0)	F03300000000035700000
	Nortier 361 (Portion 0)	F03300000000036100000
	Nortier 361 (Portion 1)	F03300000000036100001

Item	Description	
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	Palmietkuil 328 (Portion 5)	F03300000000032800005
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	Paulina 470 (Portion 0)	F03300000000047000000
	Pleasant View No 169 (Portion 0)	F03300000000016900000
	Plecy No 82 (Portion 0)	F03300000000008200000
	Richelieu 135 (Portion 0)	F03300000000013500000
	Rondehoek 200 (Portion 0)	F03300000000020000000
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	Rondehoek 200 (Portion 3)	F03300000000020000003
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	Toulon 368 (Portion 0)	F03300000000036800000
	Vaalbank 190 (Portion 1)	F03300000000019000001
	Vermeulenskraal No 223 (Portion 2)	F03500000000022300002
	Vermeulenskraal No 223 (Portion 6)	F03500000000022300006

Item	Description	
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	Vlakpan 358 (Portion 0)	F03300000000035800000
	Vlakpan 358 (Portion 1)	F03300000000035800001
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	Vlakpan 358 (Portion 3)	F03300000000035800003
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	Welgelegen 382 (Portion 11)	F03300000000038200011
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	Welgelegen 382 (Portion 28)	F03300000000038200028
	Welgelegen 382 (Portion 5)	F03300000000038200005
	Welgelegen 534 (Portion 2)	F03300000000053400002
	Weltevrede 638 (Portion 0)	F03300000000063800000
	Weltevreden 443 (Portion 14)	F03300000000044300014
	Weltevreden 443 (Portion 2)	F03300000000044300002
	Weltevreden 443 (Portion 3)	F03300000000044300003
	Weltevreden 443 (Portion 4)	F03300000000044300004
	Weltevreden 443 (Portion 5)	F03300000000044300005
	Weltevreden 443 (Portion 6)	F03300000000044300006
	Weltevreden 443 (Portion 9)	F03300000000044300009
	Werda No 587 (Portion 0)	F03300000000058700000
	Wolvepan No 85 (Portion 7)	F03900000000008500007
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Item	Description	
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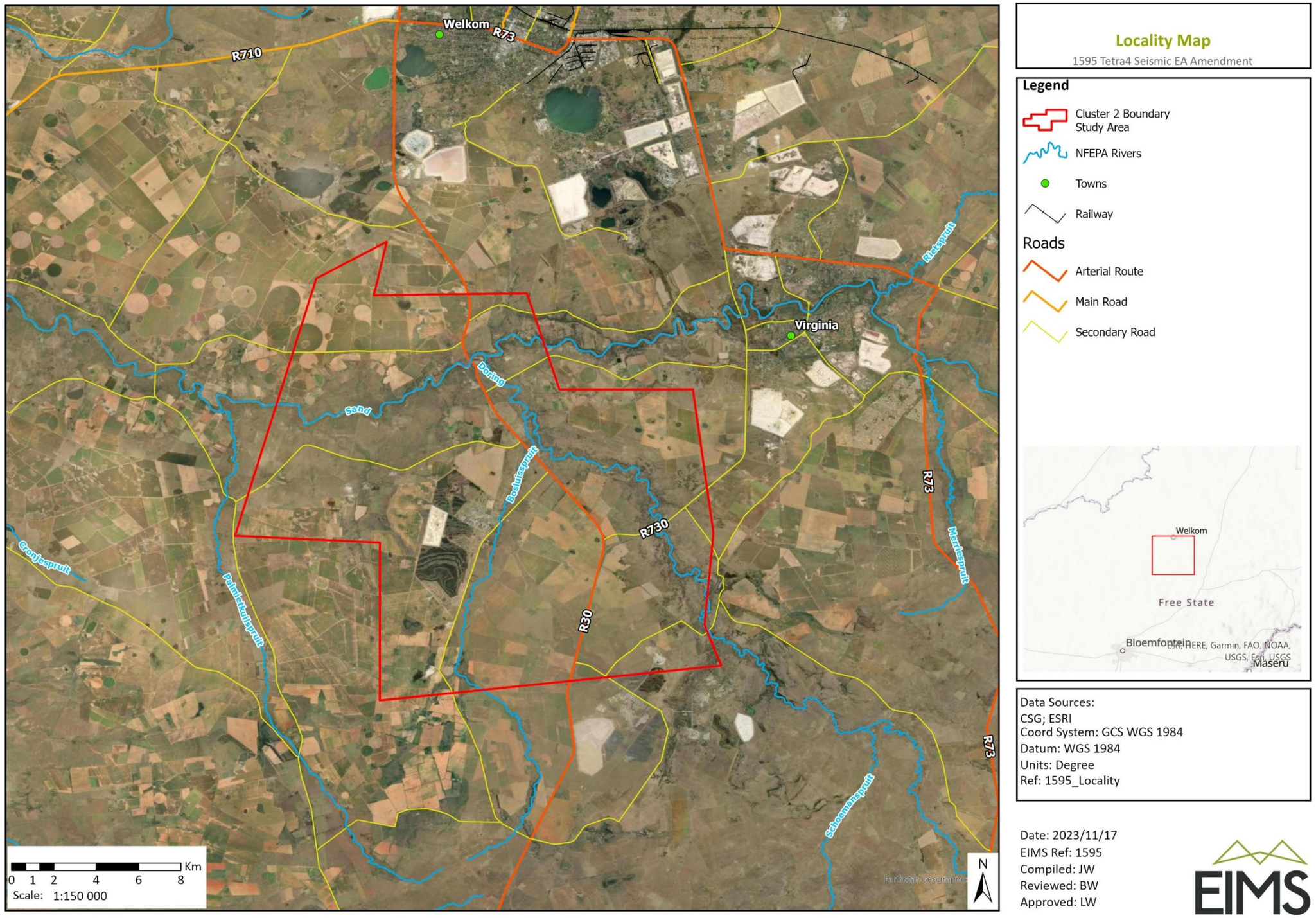


Locality Map

1595 Tetra4 Seismic EA Amendment

Legend

- Cluster 2 Boundary Study Area
- NFEPA Rivers
- Towns
- Railway

Roads

- Arterial Route
- Main Road
- Secondary Road

Data Sources:
CSG; ESRI
Coord System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
Ref: 1595_Locality

Date: 2023/11/17
EIMS Ref: 1595
Compiled: JW
Reviewed: BW
Approved: LW

Figure 1: Locality map.

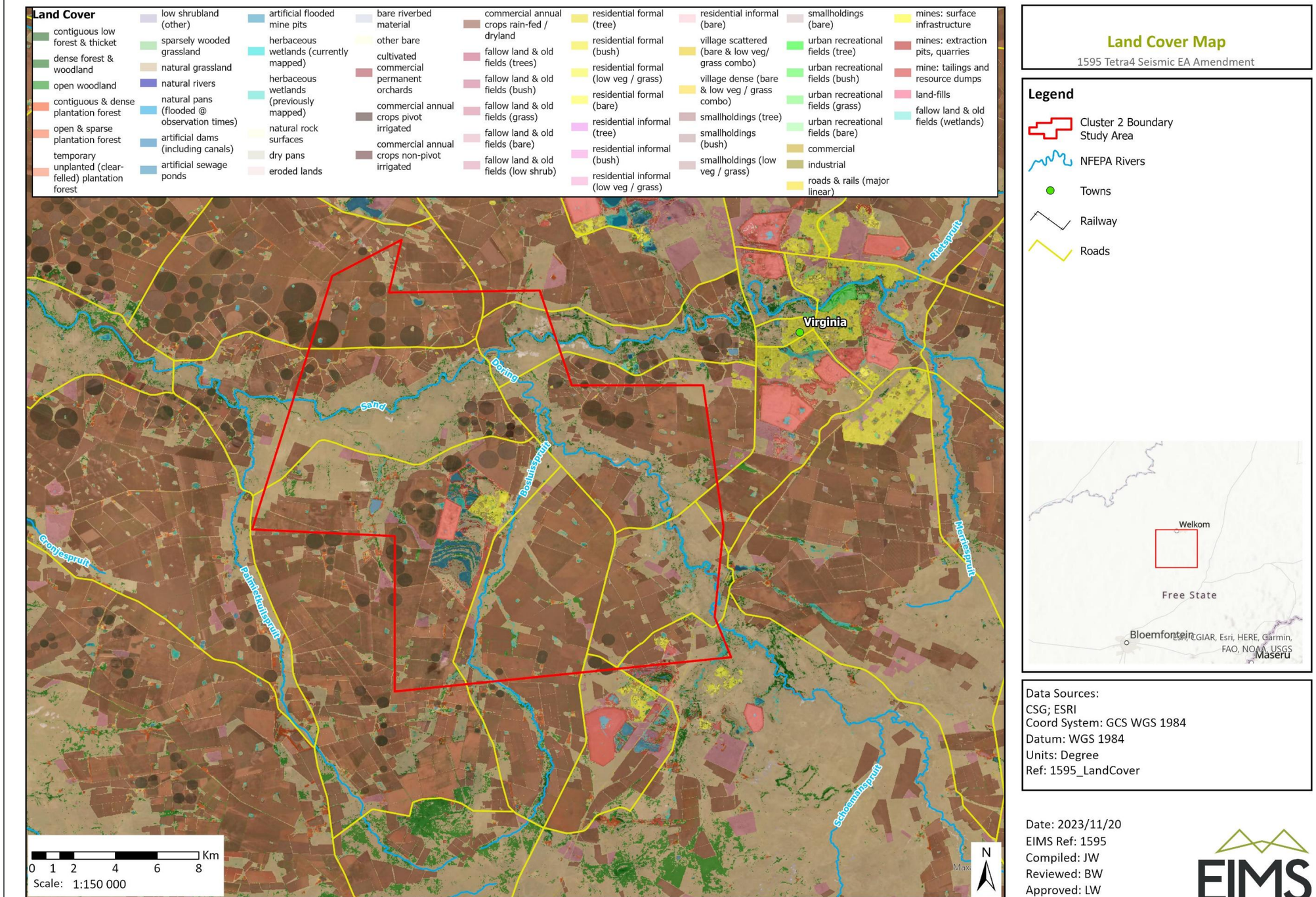


Figure 2: Land cover in the study area.

3 DESCRIPTION AND SCOPE OF THE PROPOSED ACTIVITY

This section contains a detailed description of the proposed seismic survey activities with its associated infrastructure. At the end of this section, the applicable listed activities relating to the project are presented.

3.1 PROJECT DESCRIPTION

In 2022, Tetra4 (the applicant) commenced with an application for Environmental Authorisation for the Cluster 2 gas production activities which would form an extension to the existing Cluster 1 gas production being undertaken near Virginia in the Free State Province. The application followed a full Scoping and Environmental Impact Assessment process which culminated in a positive Environmental Authorisation being issued (PASA ref.: 12/4/007). Appeals were subsequently lodged against the decision which included new information that was not submitted during the previous EIA phase public consultation period. The Applicant has since undertaken further investigations and submitted an updated EIA Report for reconsideration to the Competent Authority (in this case the Department of Mineral Resources and Energy). This updated EIA Report has been prepared to address the recommendations and shortcomings identified in the Ministers decision and is currently awaiting a decision from the Competent Authority. The Cluster 2 EA authorised various production well transects where drilling could occur with little to no specific drilling locations which resulted in some uncertainty from landowners. In order to mitigate this uncertainty and provide landowners with specific drilling locations, Tetra4 proposes undertaking a 3D seismic survey over the Cluster 2 area which would provide a high resolution subsurface geological profile and enable Tetra4 to visualise gas placement in the sub-surface and thereby enable more accurate identification of proposed drill sites on specific properties.

The proposed seismic acquisition methodology includes utilising an autonomous nodal system supplied by STRYDE, paired with vibroseis energy acquisition executed by Polaris Natural Resources. The operational configuration entails the deployment of subsurface autonomous receivers and the concurrent operation of five Nomad 65 vibroseis units (Figure 3).

The receiving array will be composed of STRYDE autonomous nodes (Figure 4), which are deployed below the surface at an approximate depth of 45 cm to 60 cm. A primary operational and environmental advantage of this system is the complete elimination of interconnecting telemetry cabling.

The utilisation of this wireless nodal technology materially mitigates surface disturbance. Furthermore, the subsurface deployment allows the majority of normal land use activities to continue undisturbed during the data acquisition phase. The only exception applies to areas undergoing active deep soil disturbance, such as agricultural ploughing. To avoid interference, seismic survey operations will not be conducted concurrently with active ploughing or similar soil-disturbing activities in a given area.

The seismic energy source will be generated by a fleet of five Nomad 65 vibroseis trucks, operated by Polaris Natural Resources. The Nomad 65 is a standard mid-range, heavy-duty vibroseis vehicle designed for efficient, low-impact onshore seismic exploration.

The approximate physical and operational specifications for each Nomad 65 unit are as follows:

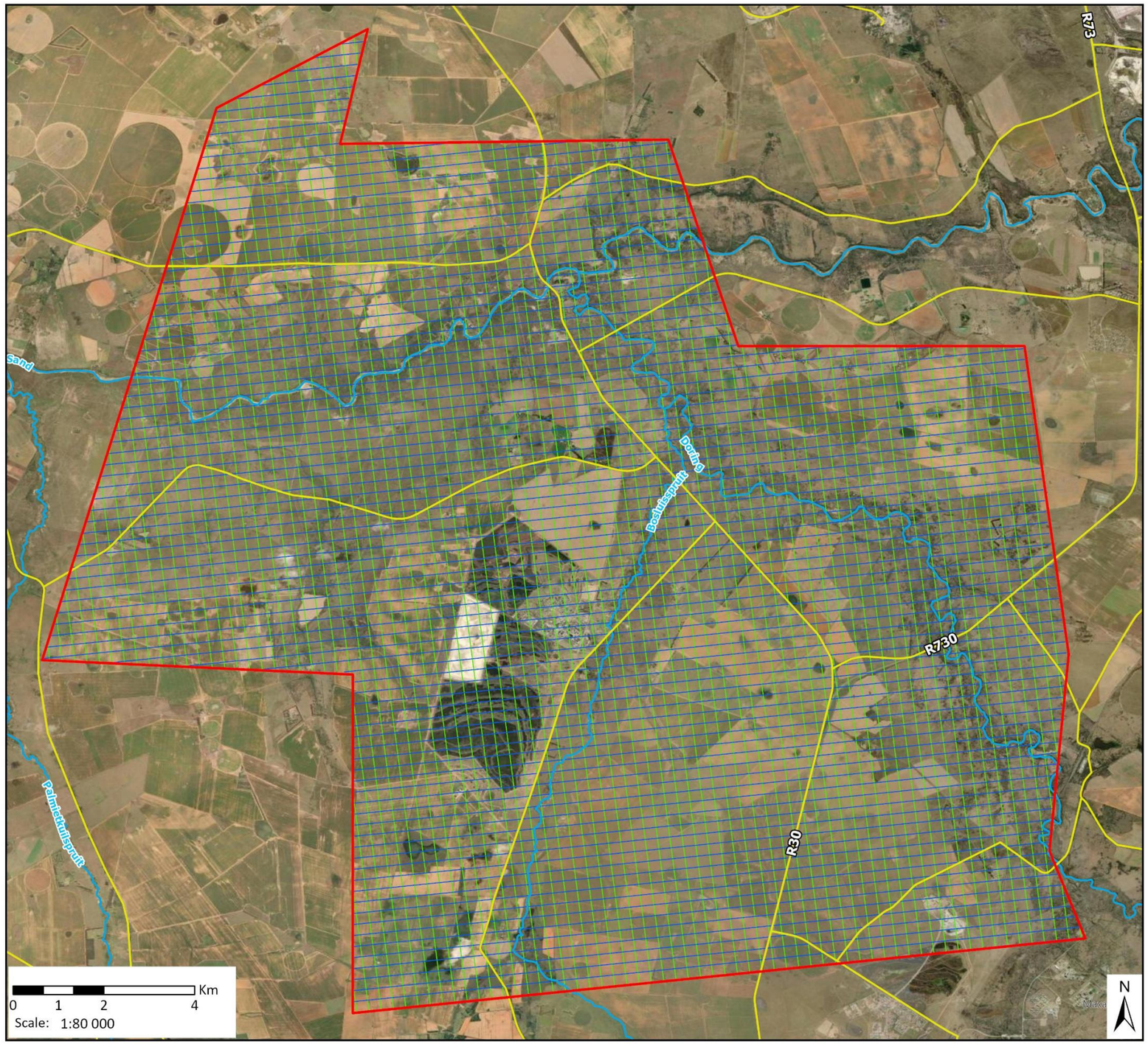
- Length: ~10.6 m
- Width: ~3.42 m
- Height: ~3.2 m
- Gross Vehicle Weight: ~31.7 tonnes
- Hold-down Force: ~28.3 tonnes equivalent

While the Nomad 65 units are conventional industry vehicles, their physical dimensions—specifically the width of approximately 3.42 m and a gross vehicle weight of 31.7 tonnes—will dictate specific logistical routing. Navigation through certain portions of the project footprint will necessitate limited, temporary access provision. This is primarily required to accommodate the width constraints of the vehicles and ensure safe manoeuvrability

without causing unintended peripheral disturbance to surrounding vegetation or infrastructure. Site-specific access routing will be strictly managed in accordance with the Environmental Management Programme (EMPr) to ensure that the required vehicle footprint remains highly localized, temporary, and strictly confined to approved corridors.

Figure 3: A Nomad 65 vibroseis truck (Industry, 2026).

Figure 4: A STRYDE's Node™. Wireless nodal system to be used as the land seismic receiver system in conjunction with the Nomad 65 vibroseis trucks (STRYDE, 2022).

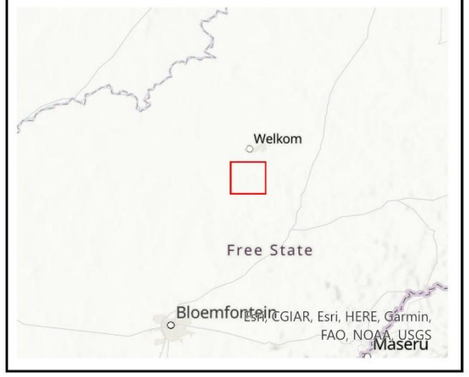


Seismic Source and Receiver Lines Map

1595 Tetra4 Seismic EA Amendment

Legend

- Cluster 2 Boundary Study Area
- NFEPA Rivers
- Seismic Source Lines
- Seismic Receiver Lines
- Roads



Data Sources:
CSG; ESRI
Coord System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
Ref: 1595_SeismicLines

Date: 2023/11/17
EIMS Ref: 1595
Compiled: JW
Reviewed: BW
Approved: LW

Figure 5: Seismic source and receiver lines map.

4 POLICY AND LEGISLATIVE CONTEXT

This section provides an overview of the governing legislation identified which may relate to the proposed project. The primary legal requirement for this project stems from the need for an environmental authorisation to be granted by the competent authority, which is the Department of Mineral and Petroleum Resources (DMPR) (Petroleum Agency of South Africa – PASA, being the delegated authority), in accordance with the requirements of both the NEMA and MPRDA. In addition, there are numerous other pieces of legislation governed by many acts, regulations, standards, guidelines and treaties on an international, national, provincial and local level, which should be considered in order to assess the potential applicability of these for the proposed activity. The key legislation applicable to this project is discussed in the subsections below.

4.1 NATIONAL LEGISLATION

This section provides an overview of the governing legislation identified which may relate to the proposed project. The primary legal requirement for this project stems from the need for an EA to be granted by the competent authority, which is the DAERL, in accordance with the requirements of the NEMA EIA Regulations 2014, as amended. In addition, there are numerous other pieces of legislation governed by many acts, regulations, standards and guidelines on an international, national, provincial and local level, which should be considered in order to assess the potential applicability of these for the proposed activity. The key legislation applicable to this project is discussed in the subsections below. The contents of this report are based on a review of the information that was available at the time of the compilation of the report. The discussion in this chapter is by no means an exhaustive list of the legal obligations of the applicant in respect of environmental management for the proposed project.

4.1.1 CONSTITUTION OF THE REPUBLIC OF SOUTH AFRICA

The constitution of any country is the supreme law of that country. The Bill of Rights in chapter 2 section 24 of the Constitution of South Africa Act (Act No. 108 of 1996) makes provisions for environmental issues and declares that: *"Everyone has the right -*

a) to an environment that is not harmful to their health or well-being; and

b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

***i.** prevent pollution and ecological degradation;*

***ii.** promote conservation; and*

iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development".

The EIA and associated impact mitigation actions are conducted to fulfil the requirement of the Bill of Rights.

4.1.2 MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT

The aim of the Minera and Petroleum Resources Development Act (Act No. 28 of 2002, MPRDA) is to "*make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources*". The MPRDA outlines the procedural requirements that need to be met to acquire mining rights in South Africa. The MPRDA also requires adherence with related legislation, chief amongst them is the National Environmental Management Act (Act No. 107 of 1998, NEMA) and the National Water Act (Act No. 36 of 1998, NWA). Since seismic activities are considered as part of the exploration phase, adherence to the MPRDA and the relevant Regulations remains a requirement.

4.1.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT

The main aim of the National Environmental Management Act (Act 107 of 1998 – NEMA) is to provide for co-operative governance by establishing decision-making principles on matters affecting the environment. In terms of the NEMA EIA Regulations, the applicant is required to appoint an EAP to undertake the BA process, as well as conduct the public participation process towards an application for EA. In South Africa, BAs became a legal

requirement in 1997 with the promulgation of regulations under the Environment Conservation Act (ECA). Subsequently, NEMA was passed in 1998. Section 24(2) of NEMA empowers the Minister and any MEC, with the concurrence of the Minister, to identify activities which must be considered, investigated, assessed and reported on to the competent authority responsible for granting the relevant EA. On 21 April 2006, the Minister of Environmental Affairs and Tourism (now Department of Forestry, Fisheries and the Environment – DFFE) promulgated regulations in terms of Chapter 5 of the NEMA. These regulations, in terms of the NEMA, were amended a number of times between 2010 and 2022. The NEMA EIA Regulations, 2014, as amended, are applicable to this project. Exploration and Production activities officially became governable under the NEMA EIA Regulations in December 2014 with the competent authority identified as the Department of Mineral Resources and Energy (DMRE).

The objective of the EIA Regulations is to establish the procedures that must be followed in the consideration, investigation, assessment and reporting of the listed activities that are triggered by the proposed project. The purpose of these procedures is to provide the competent authority with adequate information to make informed decisions which ensure that activities which may impact negatively on the environment to an unacceptable degree are not authorised, and that activities which are authorised are undertaken in such a manner that the environmental impacts are managed to acceptable levels.

NEMA sets out the general objectives of IEM in South Africa, including to (section 23(2)), of which the following two are of relevance for this report:

- Identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage, the risks and consequences and alternatives and options for mitigation of activities. This is to be done with a view to minimising negative impacts, maximising benefits and promoting compliance with the principles of environmental management set out in section 2 (of NEMA).
- Ensure that the effects of activities on the environment receive adequate consideration before actions are taken in connection with them.

4.1.3.1 LISTED ACTIVITIES

In accordance with the provisions of Sections 24(5) and Section 44 of the NEMA the Minister has published Regulations (GN R. 982) pertaining to the required process for conducting EIA's in order to apply for, and be considered for, the issuing of an EA. These EIA Regulations provide a detailed description of the process to be followed when applying for EA for any listed activity.

In terms of these regulations a Basic Assessment process is required for the proposed project. Table 6 identifies the listed activities the proposed project triggers and consequently requires authorisation prior to commencement.

Table 6: NEMA listed activities to be authorised.

Activity	Activity Description	Applicability
GNR 983: LN1 Activity 21C	Any activity including the operation of that activity associated with an onshore seismic survey which requires an exploration right in terms of section 79 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice or in Listing Notice 3 of 2014, required to exercise the exploration right, excluding- (a) any desktop study, (b) any arial survey, and	Seismic Survey of the Tetra 4 Cluster 2 approved area.

Activity	Activity Description	Applicability
	(c) a hydraulic fracturing activity which is included in activity 20A in Listing Notice 2 of 2014, in which case that activity applies.	
GNR 983: LN1 **Activity 21D**	Any activity including the operation of that activity which requires an amendment or variation to a right or permit in terms of section 102 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity contained in this Listing Notice or in Listing Notice 3 of 2014, required for such amendment.	Change to the works program and EMPr of the Tetra4 production right

The DFFE have published a number of guidelines and protocols which have been considered in the compilation of this report and include but not limited to:

- Public Participation Guideline in terms of NEMA EIA Regulations (2017).
- Need and desirability Guideline in terms of NEMA (2012).
- National guideline on minimum information requirements for preparing Environmental Impact Assessments for mining act activities that require environmental authorisation (2018).
- 2004 Information Series covering various aspects of the EIA process.
- Procedures for assessment and minimum criteria for specialist studies.

4.1.3.2 SCREENING TOOL

A Screening Tool Report was generated from the DFFE Screening tool as per the requirements of Regulation 16 (1)(b)(v) of the EIA Regulations 2014, as amended, and was included in the Application for EA. The Screening Tool provided a list of specialist studies for consideration and inclusion in the process. The Screening Tool identified environmental sensitivities are presented in Table 7.

Table 7: Screening Tool environmental sensitivities.

Theme	Sensitivity			
	Very High	High	Medium	Low
Agriculture Theme	X			
Animal Species Theme			X	
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme		X		
Civil Aviation Theme		X		
Defence Theme				X
Palaeontology Theme	X			

Theme	Sensitivity			
	Very High	High	Medium	Low
Plant Species Theme				**X**
Terrestrial Biodiversity Theme	**X**			

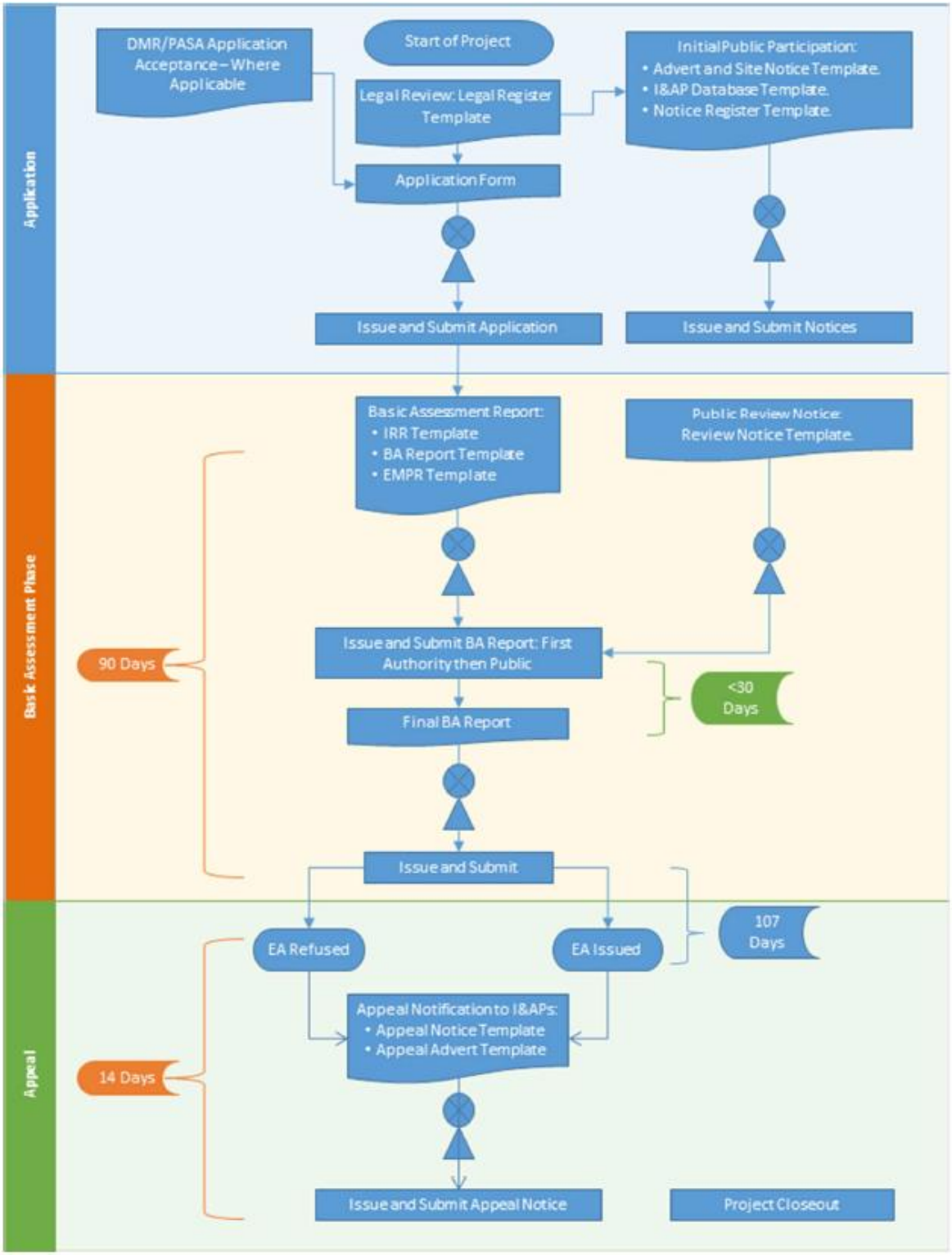


Figure 6: BA process diagram.

NEMA is the main Environmental Legislation in South Africa and other Specific Environmental Management Acts (SEMA's) support its objectives. Examples of SEMA's include the following:

- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008);
- National Water Act, 1998 (Act No. 36 of 1998);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004); and

- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004).

The key principles of NEMA, as outlined in Chapter 3 of the Act, can be summarised as follows:

- Sustainability must be pursued in all developments to ensure that biophysical and socio-economic aspects are protected; or
- there must be equal access to environmental resources, services and benefits for all citizens including the disadvantaged and the vulnerable. Adverse environmental impacts shall be distributed fairly among all citizens;
- environmental governance must include the participation of all interested and affected parties who must be catered for to allow their effective participation;
- environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably; and
- the polluter pays principle must be applied in all cases where any person has caused pollution or undertaken any action that led to the degradation of the environment.

4.1.3.3 NEMA ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, 2014 AS AMENDED

In terms of section 24(2) of NEMA, the Minister and or any MEC in concurrence with the Minister may identify activities that require authorisation as these activities may negatively affect the environment. The Act requires that in such cases the impacts must be considered, investigated and assessed before their implementation, and reported to the organ of state charged by law with authorising, permitting, or otherwise allowing the implementation of an activity. The NEMA EIA Regulations guide the processes required for the assessment of impacts of Listed Activities.

The requirement for the undertaking of Environmental Impact Assessments and Basic Assessments began in 1997 with the promulgation of the EIA Regulations under the Environment Conservation Act, 1989 (ECA) (Act No. 73 of 1989). These were followed by the 2006, 2010, 2014 and 2021 regulations. The scoping and EIA process for the proposed project is undertaken in terms of the NEMA EIA Regulations, 2014, as amended.

4.1.3.4 THE NATIONAL WEB-BASED ENVIRONMENT SCREENING TOOL, 2019

On the 5th of July 2019, the Department of Forestry, Fisheries and the Environment (DFFE) issued a Notice of the requirement to submit a report generated by the National Web-based Environmental Screening Tool in terms of section 24(5)(h) of the NEMA, 1998 (Act No 107 of 1998) and Regulation 16(1)(b)(v) of the EIA regulations, 2014, as amended. The submission of this report is compulsory when applying for environmental authorisation in terms of Regulation 19 and Regulation 21 of the Environmental Impact Assessment Regulations, 2014 effective from the 4th of October 2019. The DFFE Screening Tool Report was generated on the 3rd of December 2024. The Screening report is provided in Appendix B of this report. The environmental sensitivities identified in screening report for the proposed development footprint are indicated on Table 8.

Table 8: Environmental sensitivity of project area.

Theme	Very High Sensitivity	High Sensitivity	Medium Sensitivity	Low Sensitivity
Agriculture Theme			X	
Animal Species Theme		X		
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme		X		

Theme	Very High Sensitivity	High Sensitivity	Medium Sensitivity	Low Sensitivity
Defence Theme				X
Palaeontology Theme		X		
Plant Species Theme			X	
Terrestrial Biodiversity Theme	X			

The information collected by the specialists and EAP's assessment may be used to confirm or dispute (as may be applicable) the environmental sensitivity ratings identified by the National Screening Tool. The Heritage and Palaeontology Assessments were undertaken during the Scoping phase, whilst the Biodiversity Assessments was undertaken during the EIA phase. The EAP has undertaken a site sensitivity verification (Appendix B) and the EAP's assessments/theme and sensitivity ratings identified by the Screening Tool are summarized in Table 9.

The DFFE Screening Report indicates that certain Specialist Assessments must be undertaken for the proposed development. There is however an allowance of the EAP to motivate for the reasons for not including certain assessments in the assessment report. A Site Sensitivity Verification Report (SSVR) has been compiled to consider the recommendations of the DFFE Screening Tool Report and to provide a rationale for the selection of specialist studies included in the assessment report. Please refer to Table 9 for a summary of the verification process, and Appendix B for the SSVR.

Table 9: SSVR findings and motivation.

Screening Tool Specialist Study Required:	Level of Sensitivity:	Suggested Sensitivity:	Required level of Assessment	Motivation
Agriculture Impact Assessment	Very High	Low	None	The impact of the proposed activity is estimated to not have a significant effect on the agriculture resources. Therefore, an agriculture assessment will not be required, however past assessment undertaken in 2022 and 2024 in the area will be included during the BA process.
Archaeological and Cultural Heritage Impact Assessment	High	High	Full Study	Given the large area of the proposed activity, resulting in a number of heritage sites being impacted potentially, an assessment will be undertaken by a professional heritage specialist registered with SAHRA.
Palaeontology Impact Assessment	Very High	High	Full Study	Given the large area of the proposed activity and the level of sensitivity identified in the screening tool, resulting in a potentially large number of palaeontological resources being impacted, an assessment will be undertaken by a professional palaeontology specialist
Terrestrial Biodiversity	Very High	Very High	Full Study	Given the large area consisting of CBA1, ESA NPAES and Vaal-Vet Sandy Grassland, the sensitivity indicated by the screening toll

Screening Tool Specialist Study Required:	Level of Sensitivity:	Suggested Sensitivity:	Required level of Assessment	Motivation
Impact Assessment				will remain the same (very high), unless categorised otherwise by the specialist if applicable. A full assessment will be undertaken by a specialist, as per the NEMA regulations GN 320.
Aquatic Biodiversity Impact Assessment	Very High	Very High	Full Study	Given the three rivers (Sandriver, Bosluisspruit and Doringriver) as well as several wetlands occurring on site, a full assessment will be undertaken by a specialist as per the NEMA GN 320 regulations
Plant Species Assessment	Low	Low	None	A plant species assessment will be undertaken as part of the terrestrial and aquatics assessment
Animal Species Assessment	Medium	Medium	None	An animal species assessment will be undertaken as part of the terrestrial and aquatics assessment
Civil Aviation Theme	High	Low	None	This activity is determined to not have a significant impact on civil aviation, however the civil aviation authorities will be included in the I&AP database.
Defence Theme	Low	Low	None	Due to the low sensitivity of the defence theme, no assessment is deemed to be necessary.
Hydrology Assessment	Not Applicable		None	Given the proposed activities will not have a major effect, and will avoid watercourses, this impact is considered low and an assessment will not be required. A riverine Assessment will however be undertaken.
Socio-Economic Assessment	Not Applicable		None	In the EAP's professional opinion, a standalone Socio-Economic Assessment is not required for this application. This determination is based on the temporary duration of the survey and its location within non-residential, agricultural, and mining zones. By scheduling operations to coincide with fallow seasonal rotations, the project effectively mitigates potential economic impacts on farming activities, resulting in a low-significance socio-economic footprint.
Landscape / Visual Assessment	Not Applicable		None	In the EAP's professional opinion, a dedicated Landscape or Visual Assessment is not warranted. This determination is

Screening Tool Specialist Study Required:	Level of Sensitivity:	Suggested Sensitivity:	Required level of Assessment	Motivation
				based on the project's negligible visual footprint, as operations are limited to a mobile vibroseis convoy with no long-term modifications to the existing landscape. Any visual presence is temporary and confined to the duration of the survey.

4.1.4 THE NATIONAL WATER ACT

The National Water Act, 1998 (Act 36 of 1998 – NWA) makes provision for two types of applications for water use licences, namely individual applications and compulsory applications. The NWA also provides that the responsible authority may require an assessment by the applicant of the likely effect of the proposed licence on the resource quality, and that such assessment be subject to the NEMA EIA Regulations. These water use processes are described in Figure 7. A person may use water if the use is –

- Permissible as a continuation of an existing lawful water use;
- permissible in terms of a general authorisation (GA);
- permissible under Schedule 1; or
- authorised by a licence.

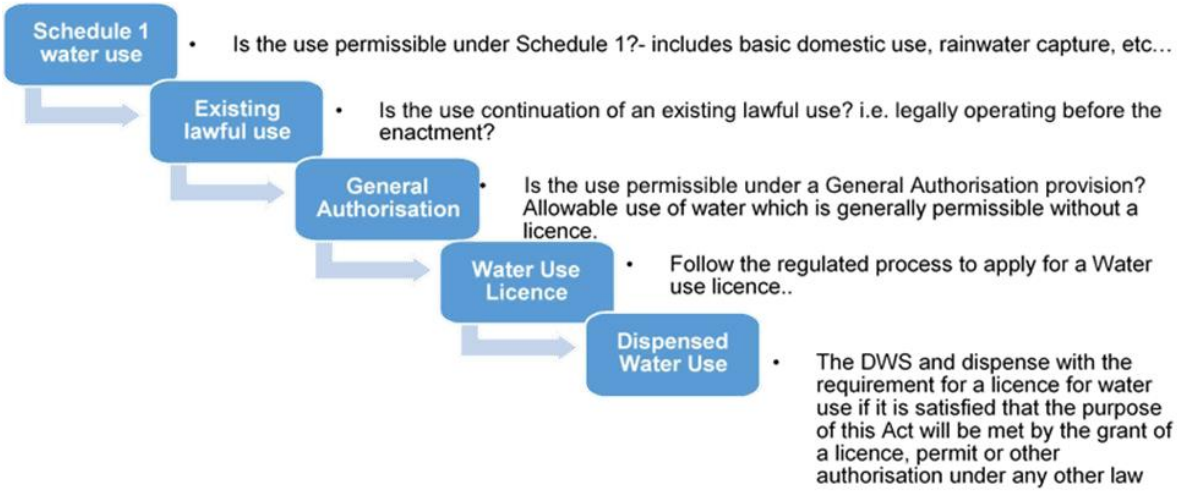


Figure 7: Authorisation Process for new water uses.

The purpose of the NWA is to ensure that the nation's water resources are protected, used, developed, conserved and managed in ways that take into account:

- Meeting basic human needs of present and future generations;
- Promoting equitable access to water;
- Redressing the results of past racial discrimination;
- Promoting the efficient, sustainable and beneficial use of water in the public interest; facilitation social and economic development;

- Providing for the growing demand for water use;
- Protecting aquatic and associated ecosystems and their biological diversity;
- Reducing and preventing pollution and degradation of water resources;
- Meeting international obligations;
- Promoting dam safety; and
- Managing floods and drought.

The NWA defines 11 water uses in Section 21 of the Act. A water use may only be undertaken if authorised by the Department of Water and Sanitation (DWS). The water uses for which an authorisation or licence can be issued include:

(a) Taking water from a water resource;

(b) Storing water;

(c) Impeding or diverting the flow of water in a watercourse;

(d) Engaging in a stream flow reduction activity contemplated in section 36;

(e) Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);

(f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduits;

(g) Disposing of waste in a manner which may detrimentally impact on a water resource;

(h) Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;

(i) Altering the bed, banks, course or characteristics of a watercourse;

(j) Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and

(k) Using water for recreational purposes

A review of the NWA Section 21 activities was undertaken to assess if the proposed development triggers any activity. Based on the information provided by the applicant, the proposed development triggers Section 21(a) and Section 21(b) of the NWA. Subsequently, a Water Use Licence Application in concurrently underway for the project with the Department of Water and Sanitation, Northern Cape Region.

The proposed Seismic Study Project might include activities which might have a temporary impact on water resources in certain areas. The main water use that will be applicable is the Section 21 (c&i) uses for activities within proximity (or within) the regulated area of a watercourse. A watercourse is defined in terms of the Act as follows:

a) a river or spring;

b) a natural channel in which water flows regularly or intermittently;

c) a wetland, lake or dam into which, or from which, water flows; and

d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The regulated area of a watercourse for section 21(c) or (i) of the Act water uses is similarly defined in terms of the Act as follows:

a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;

b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or

c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

As part of this BA process, specialist input was obtained to delineate the watercourses within the application areas and based on this input, advise the applicant on which of the activities may require and application for a WUL. Due to the temporary duration of the project, neither a Water Use License (WUL) nor a General Authorisation (GA) is required for the proposed activities. Nevertheless, comprehensive mitigation measures have been integrated into the operational plan to ensure that any potential impacts on local watercourses are minimised and managed effectively.

4.1.4.1 CATCHMENT MANAGEMENT STRATEGIES

South Africa is divided into nineteen Water Management Areas (WMAs). The delegation of water resource management from central government to catchment level is achieved by establishing Catchment Management Agencies (CMAs) at WMA level. Each CMA progressively develops a Catchment Management Strategy (CMS) for the protection, use, development, conservation, management and control of water resources within its WMA. This is to ensure that on a regional scale, water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons. The main instrument that guides and governs the activities of a WMA is the Catchment Management Strategy (CMS) which, while conforming to relevant legislation and national strategies, provides detailed arrangements for the protection, use, development, conservation, management and control of the region's water resources. According to the DHSWS water management areas delineations, the proposed project area (Cluster 2 PR boundary) is situated in primary catchment (C) of the Vaal River drainage system which covers a total area of approximately 246 674.5 km^2. The resource management falls under the Vaal Water Management Area (WMA5) which spans portions of the North West Province, northern Free State as well northern sections of the Northern Cape. The application area is situated within quaternary catchments C42L, C42K, and C43B.

4.1.5 ENVIRONMENT CONSERVATION ACT

The Environment Conservation Act (Act 73 of 1989 – ECA) was, prior to the promulgation of the NEMA, the backbone of environmental legislation in South Africa. To date the majority of the ECA has been repealed by various other Acts, however Section 25 of the Act and the Noise Regulations (GN R. 154 of 1992) promulgated under this section are still in effect (see Section 4.1.5.1). These Regulations serve to control noise and general prohibitions relating to noise impact and nuisance. Noise nuisance is not anticipated as part of the proposed farming activities, however noise may have an impact on the fauna and therefore mitigation measures are included in this report as well as the EMPr.

4.1.5.1 NOISE CONTROL REGULATIONS, 1992

In terms of section 25 of the ECA, the National Noise Control Regulations (GN R. 154 – NCRs) published in Government Gazette No. 13717 dated 10 January 1992, were promulgated. The NCRs were revised under GN R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

The NCRs will need to be considered in relation to the potential noise that may be generated mainly during the construction and decommissioning phases of the proposed project. The two key aspects of the NCRs relate to disturbing noise and noise nuisance.

Section 4 of the Regulations prohibits a person from making, producing or causing a disturbing noise, or allowing it to be made produced or caused by any person, machine, device or apparatus or any combination thereof. A disturbing noise is defined in the Regulations as:

"a noise level which exceeds the zone sound level or if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more."

Section 5 of the NCRs in essence prohibits the creation of a noise nuisance. A noise nuisance is defined as:

"any sound which disturbs or impairs or may disturb or impair the convenience or peace of any person."

Noise nuisance is not anticipated as part of the proposed farming activities as there are no nearby noise receptors, however noise may have an impact on the fauna and therefore mitigation measures are included in this report as well as the EMPr.

4.1.5.2 **NOISE STANDARDS**

There are a few South African scientific standards (SABS) relevant to noise from mines, industry and roads. They are:

- South African National Standard (SANS) 10103:2008 – 'The measurement and rating of environmental noise with respect to annoyance and to speech communication';
- SANS 10210:2004 – 'Calculating and predicting road traffic noise';
- SANS 10328:2008 – 'Methods for environmental noise impact assessments';
- SANS 10357:2004 – 'The calculation of sound propagation by the Concave method';
- SANS 10181:2003 – 'The Measurement of Noise Emitted by Road Vehicles when Stationary'; and
- SANS 10205:2003 – 'The Measurement of Noise Emitted by Motor Vehicles in Motion'.

The relevant standards use the equivalent continuous rating level as a basis for determining what is acceptable. The levels may take single event noise into account, but single event noise by itself does not determine whether noise levels are acceptable for land-use purposes. With regards to SANS 10103:2008, the recommendations are likely to inform decisions by authorities, but non-compliance with the standard will not necessarily render an activity unlawful per se.

4.1.6 NATIONAL HERITAGE RESOURCES ACT

The National Heritage Resources Act (NHRA) (Act 25 of 1999) stipulates that cultural heritage resources may not be disturbed without authorisation from the relevant heritage authority. Section 34(1) of the NHRA states:

"no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…".

The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impacts Processes required by NEMA. This change requires us to evaluate the Section of these Acts relevant to heritage. The NEMA 23(2)(b) states that an integrated environmental management plan should:

"…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage".

A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken into account of in the EIA Regulations under the NEMA relates to the Specialist Report requirements (Appendix 6 of EIA Regulations 2014, as amended). Several Heritage resources have been identified by a Heritage Specialist (Section 8.4 and Appendix E) and the relevant impacts and mitigations have been included in this report (Section 9.3.12) and the EMPr (Appendix G).

4.1.7 CONSERVATION OF AGRICULTURE RESOURCES ACT

The law on Conservation of Agricultural Resources (Act 43 of 1983) aims to provide for the conservation of the natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants. In order to achieve the objectives of this Act, control measures related to the following may be prescribed to land users to whom they apply:

- The cultivation of virgin soil;
- the utilisation and protection of land which is cultivated;
- the irrigation of land;
- the prevention or control of waterlogging or salination of land;
- the utilisation and protection of vleis, marshes, water sponges, water courses and water sources;
- the regulating of the flow pattern of run-off water;
- the utilisation and protection of the vegetation;
- the grazing capacity of veld, expressed as an area of veld per large stock unit;
- the maximum number and the kind of animals which may be kept on veld; the prevention and control of veld fires;
- the utilisation and protection of veld which has burned;
- the control of weeds and invader plants;
- the restoration or reclamation of eroded land or land which is otherwise disturbed or denuded;
- the protection of water sources against pollution on account of farming practices;
- the construction, maintenance, alteration or removal of soil conservation works or other structures on land; and
- any other matter which the minister may deem necessary or expedient in order that the objects of this act may be achieved.

Further, different control measures may be prescribed in respect of different classes of land users or different areas or in such other respects as the Minister may determine. Impacts on the soil, biodiversity and water resources have been identified with regards to the proposed project, and mitigation and management measures recommended.

4.1.8 THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT

On 2 June 2014, the National Environmental Management: Waste Amendment Act came into force. Waste is accordingly no longer governed by the MPRDA but is subject to all the provisions of the National Environmental Management: Waste Act, 2008 (NEMWA).

Section 16 of the NEMWA must also be considered which states as follows:

1. *A holder of waste must, within the holder's power, take all reasonable measures to-*
    a) *"Avoid the generation of waste and where such generation cannot be avoided, to minimise the toxicity and amounts of waste that are generated;*
    b) *Reduce, re-use, recycle and recover waste;*
    c) *Where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner;*

d) Manage the waste in such a manner that it does not endanger health or the environment or cause a nuisance through noise, odour, or visual impacts;

e) Prevent any employee or any person under his or her supervision from contravening the Act; and

f) Prevent the waste from being used for unauthorised purposes."

These general principles of responsible waste management have been incorporated into the requirements in the EMPr to be implemented for this project. In order to attempt to understand the implications of these waste groups, it is important to ensure that the definitions of all the relevant terminologies are defined:

- Hazardous waste: means "*any waste that contains organic or inorganic elements or compounds that may, owning to the inherent physical, chemical or toxicological characteristic of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within business waste, residue deposits and residue stockpiles*."
- Residue deposits: means "*any residue stockpile remaining at the termination, cancellation or expiry of a prospecting right, mining right, mining permit, exploration right or production right*."
- Residue stockpile: means "*any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, mineral processing plant waste, ash or any other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated within the mining area for potential re-use, or which is disposed of, by the holder of a mining right, mining permit or, production right or an old order right, including historic mines and dumps created before the implementation of this Act*."
- General waste: means "*waste that does not pose an immediate hazard or threat to health or to the environment and includes – domestic waste; building and demolition waste; business waste; inert waste; or any waste classified as non-hazardous waste in terms of the regulations made under Section 69.*"

Furthermore, the NEMWA provides for specific waste management measures to be implemented, as well as providing for the licensing and control of waste management activities. The Production Extension Project with the associated activities triggers waste management activities in terms of Category A as well as Category B of GN 921, the latter of which states that "*a person who wishes to commence, undertake or conduct an activity listed under this Category, must conduct an environmental impact assessment process, as stipulated in the environmental impact assessment regulations made under section 24(5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as part of a waste management licence application*."

Although it is expected that no waste, with the exception of general/domestic waste, will be generated during the course of this project, the applicant should be made aware of the NEM:WA and the relevant regulations. Impacts and Mitigation measures will be considered for the generation of all possible waste streams and will be included in the EMPr.

4.1.9 THE NATIONAL ENVIRONMENTAL MANAGEMENT BIODIVERSITY ACT

The National Environmental Management Biodiversity Act (Act No. 10 of 2004 – NEM: BA) provides for the management and conservation of South Africa's biodiversity within the framework of the NEMA as well as the protection of species and ecosystems that warrant national protection. Within the framework of this act, various regulations are promulgated which provide specific requirements and management measures relating to protecting threatened ecosystems, threatened or protected species as well as the control of alien and invasive species. A summary of these regulations is presented below.

4.1.9.1 **THE LIST OF ECOSYSTEMS THAT ARE THREATENED AND NEED OF PROTECTION, 2011**

The NEM: BA provides for listing of threatened or protected ecosystems in one of the following categories:

- Critically Endangered (CR) ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation;
- Endangered (EN) ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems;
- Vulnerable (VU) ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and
- Protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed as critically endangered, endangered or vulnerable.

4.1.9.2 THE THREATENED OR PROTECTED SPECIES REGULATIONS, 2007

The purpose of these regulations is to -

a. further regulate the permit system set out in Chapter 7 of the Biodiversity Act insofar as that system applies to restricted activities involving specimens of listed threatened or protected species;
b. provide for the registration of captive breeding operations, commercial exhibition facilities, game farms, nurseries, scientific institutions, sanctuaries and rehabilitation facilities and wildlife traders;
c. provide for the regulation of the carrying out of a specific restricted activity, namely hunting;
d. provide for the prohibition of specific restricted activities involving specific listed threatened or protected species;
e. provide for the protection of wild populations of listed threatened species; and
f. provide for the composition and operating procedure of the Scientific Authority.

4.1.9.3 THE ALIEN AND INVASIVE SPECIES LIST, 2020

This Act is applicable since it protects the quality and quantity of arable land in South Africa. Loss of arable land should be avoided and declared Weeds and Invaders in South Africa are categorised according to one of the following categories, and require control or removal:

- *Category 1a Listed Invasive Species*: Category 1a Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be combated or eradicated;
- *Category 1b Listed Invasive Species*: Category 1b Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be controlled;
- *Category 2 Listed Invasive Species:* Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be; and
- *Category 3 Listed Invasive Species*: Category 3 Listed Invasive Species are species that are listed by notice in terms of section 70(1)(a) of the Act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of Act, as specified in the Notice.

Based on desktop information including the National Web-Based Environmental Screening Tool Report, the study area was assessed to be located within a Critical Biodiversity Area (CBA) 1 and CBA 2, Ecological Support Area (ESA) 1 and ESA 2 as well as within a National Protected Area Expansion Strategy (NPAES) within the *endangered* Vaal-Vet Sandy Grasslands. A Terrestrial Biodiversity Assessment (flora, fauna and avifaunal) was considered necessary and has been undertaken during this BA Phase. The study identified Endangered Ecosystems, Critical Biodiversity Areas, Ecological Support Areas, Conservation Targets and Ecological Drivers of the ecosystem as well as alien and invasive species. Where sensitive species or ecosystem drivers were identified, relevant mitigation measures have been put forward to prevent or minimise the impacts. The findings

and impact assessment are discussed in Sections 9.3.8, 9.3.9 and 9.3.10, as well as Appendix E in the specialist's report.

4.1.10 THE NATIONAL ENVIRONMENTAL MANAGEMENT AIR QUALITY ACT

The National Environmental Management: Air Quality Act (Act No. 39 of 2004 as amended – NEM: AQA) is the main legislative tool for the management of air pollution and related activities. The Objective of the Act is:

To protect the environment by providing reasonable measures for –

i. the protection and enhancement of the quality of air in the republic;

ii. the prevention of air pollution and ecological degradation; and

iii. securing ecologically sustainable development while promoting justifiable economic and social development; and

iv. Generally, to give effect to Section 24(b) of the constitution in order to enhance the quality of ambient air for the sake of securing an environment that is not harmful to the health and well-being of people.

The NEM:AQA mandates the Minister of Environment to publish a list of activities which result in atmospheric emissions and consequently cause significant detrimental effects on the environment, human health and social welfare. All scheduled processes as previously stipulated under the Air Pollution Prevention Act (APPA) are included as listed activities with additional activities being added to the list. The updated Listed Activities and Minimum National Emission Standards were published on the 22nd of November 2013 (Government Gazette No. 37054).

According to the NEM:AQA, air quality management control and enforcement is in the hands of local government with District and Metropolitan Municipalities as the licensing authorities. Provincial government is primarily responsible for ambient monitoring and ensuring municipalities fulfil their legal obligations, with national government primarily as policy maker and co-ordinator. Each sphere of government must appoint an Air Quality Officer responsible for co-ordinating matters pertaining to air quality management. Given that air quality management under the old Act was the sole responsibility of national government, local authorities have in the past only been responsible for smoke and vehicle tailpipe emission control.

While the anticipated air quality impacts from the listed activities are not projected to be significant, adherence to the NEM: AQA and the National Dust Control Regulations, where relevant, remains a requirement.

4.1.10.1 **THE NATIONAL DUST CONTROL REGULATIONS, 2013**

The National Dust Control Regulations (GN R 7335, 2026), published under the National Environmental Management: Air Quality Act (Act 39 of 2004), establish a framework for managing dust emissions across various industrial sectors. These regulations apply primarily to entities involved in mining, exploration, and other high-impact activities that are likely to generate fugitive dust. The primary objective is to enforce standardised control measures that prevent dust from becoming a public nuisance or an environmental hazard, particularly in areas near sensitive receptors such as schools and hospitals.

To ensure compliance, the document defines specific dustfall standards categorized by land use. For residential areas, the permissible dustfall rate is capped at 600 mg/m²/day, while non-residential or industrial areas are permitted up to 1200 mg/m²/day. These rates are measured over a 30-day average, and the regulations allow for only two non-sequential exceedances per year. Any entity conducting activities covered by these regulations must implement a formal monitoring program utilizing the SANS 1137 standard to verify adherence to these limits.

Furthermore, the regulations mandate the development and submission of a comprehensive Dust Management Plan (DMP). This plan must identify all potential dust sources and outline specific, time-bound mitigation strategies to minimize impact. In addition to technical controls, the DMP must include a procedure for managing public complaints and require monthly progress reports to be submitted to the relevant air quality officer. Failure to comply with these directives carries significant legal consequences, including potential fines of up to R5 million or imprisonment for up to five years for initial offenses.

4.1.11 THE NATIONAL FOREST ACT (NFA)

According to this Act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that *"no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister."*

4.1.12 NATIONAL VELD AND FOREST FIRE ACT

The National Veld and Forest Fire Act (Act 101 of 1998) is a key piece of legislation in South Africa aimed at reforming the legal framework surrounding veld and forest fires. Its primary purpose is to prevent and manage wildfires through coordinated efforts, particularly in rural and fire-prone areas. The Act encourages the formation of Fire Protection Associations (FPAs), which are legally recognized bodies that facilitate local collaboration among landowners, municipalities, and other stakeholders to predict, prevent, and suppress veldfires. These associations play a vital role in fire management by offering training, support, and technical expertise to their members.

For private developers and landowners, the Act imposes several important obligations. They are legally required to take reasonable precautions to prevent fires from starting or spreading from their property. This includes maintaining firebreaks, ensuring that controlled burns are conducted safely and in accordance with regulations, and joining or cooperating with local FPAs. Failure to meet these responsibilities can result in legal liability, especially if negligence leads to damage or loss caused by a fire. In such cases, landowners may face civil claims for damages, making it essential for them to understand and comply with the Act's provisions.

In essence, the Act not only promotes proactive fire management but also establishes a framework for accountability. Private developers and landowners must be vigilant and informed, as their actions—or lack thereof—can have significant legal and financial consequences. By participating in FPAs and adhering to fire safety regulations, they contribute to a safer and more resilient environment for their communities and the broader ecosystem.

4.1.13 THE SPATIAL PLANNING AND LAND USE MANAGEMENT ACT

The Spatial Planning and Land Use Management (Act 16 of 2013 – SPLUMA) is set to aid effective and efficient planning and land use management, as well as to promote optimal exploitation of minerals and mineral resources. The SPLUMA was developed to legislate for a single, integrated planning system for the entire country. Therefore, the Act provides a framework for a planning system for the country and introduces provisions to cater for development principles; norms and standards; inter-governmental support; Spatial Development Frameworks (SDFs) across national, provincial, regional and municipal areas; Land Use Schemes (LUS); and municipal planning tribunals.

4.1.14 THE OCCUPATIONAL HEALTH AND SAFETY ACT

The Occupational Health and Safety Act (Act 85 of 1993 - OHSA) is designed to provide for the health and safety of persons at work and in connection with the use of plant and machinery. Its primary objective is to protect employees and other individuals from hazards arising from or associated with activities at workplaces.

Key provisions of the OHSA establish a shared responsibility model, obligating both employers and employees to actively contribute to minimising workplace risks. Employers are mandated to provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of their employees. This includes, but is not limited to:

- Identifying and eliminating or mitigating hazards.
- Providing and maintaining safe systems of work, plant, and machinery.
- Ensuring the safe production, processing, use, handling, storage, and transport of articles and substances.
- Providing necessary information, instructions, training, and supervision.

- Establishing and maintaining a health and safety policy, often signed by the Chief Executive Officer, outlining the organization's commitment.
- Conducting regular risk assessments to identify and evaluate potential hazards and implement control measures.
- Providing appropriate Personal Protective Equipment (PPE) free of charge and ensuring its correct use and maintenance.

Employees, in turn, are responsible for taking reasonable care of their own health and safety and that of others who may be affected by their actions or omissions. They must comply with health and safety rules and procedures, report unsafe conditions, and cooperate with employers to fulfil the Act's requirements.

The OHSA also provides for the establishment of Health and Safety Representatives and Committees in workplaces with more than 20 employees, fostering a collaborative approach to safety management. The Department of Employment and Labour enforces the Act, with inspectors empowered to conduct unannounced visits, request documentation, and investigate incidents. Non-compliance can lead to legal repercussions, including criminal liability for negligence.

The OHSA aims to proactively prevent work-related injuries, illnesses, and fatalities by setting legally enforceable standards and fostering a culture of health and safety awareness and accountability across all sectors, excluding mining (which is governed by separate legislation).

4.2 OTHER APPLICABLE ACTS AND LOCAL OR INTERNATIONAL GUIDELINES OR STANDARDS

Other applicable acts and guidelines include: The National Veld and Forest Fire Act 101 of 1998; and Masilonyana and Matjhabeng Local Municipalities Integrated Development Plans. In addition, the municipal planning documents such as the Local Municipality By-laws on Spatial Planning and Land-use Management are also applicable to the project. These Acts, Ordinances, plans and guidelines have been considered in the preparation of this report.

In addition to the relevant provincial or local guidelines, there exists various international guidelines or standards that have relevance to this project and application, and these are described below.

4.2.1 FREE STATE NATURE CONSERVATION ORDINANCE 8 OF 1969

This Ordinance makes provision with respect to the protection and conservation of wildlife in the Free State Province. It makes provision for, among other things, hunting and the protection of wild animals, fishing and the protection of aquatic resources, the protection of indigenous plants and the establishment and management of nature reserves. The Ordinance defines, in Schedule1, protected game and, in Schedule 2, ordinary game and sets out specific rules relating to hunting of each class of game. It also defines prohibited acts in respect of wild or exotic game and rules regarding the importation and exportation of endangered or exotic animals. According to the list of protected species under the Schedule, if any individuals of these plant species are to be disturbed, permits must be obtained from the Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs (FSDESTEA). An assessment of floral species within the study area is covered by the Terrestrial Biodiversity Assessment and discussed in detail in subsequent sections of the report.

4.2.2 FREE STATE PROVINCIAL SPATIAL DEVELOPMENT PLAN

The Free State Provincial Spatial Development Framework (PSDF) is a policy document that promotes a ‘developmental state’ in accordance with national and provincial legislation and directives. It aligns with the Free State Provincial Growth and Development Strategy which has committed the Free State to ‘building a prosperous, sustainable and growing provincial economy which reduces poverty and improves social development’. The PSDF includes comprehensive plans and strategies that collectively indicate which type of land-use should be promoted in the Free State Province, where such land-use should take place, and how it should be implemented and managed. The proposed exploration activities are within an approved exploration right.

4.2.3 FREE STATE BIODIVERSITY PLAN, 2015

The development of provincial biodiversity plans is a key component of the systematic biodiversity planning in South Africa and therefore a strong focus of the Biodiversity Planning Forum. Many of the innovative approaches and methodologies have been initiated and established through the development of these provincial biodiversity plans. A key objective of the Provincial Spatial Development Framework (PSDF) is to integrate and standardize planning at all spheres of government in the province with specific reference to amongst others facilitating land-use classification of the entire land surface of the province. To this extent a set of dedicated Spatial Planning Categories (SPCs) were developed which provide a spatial framework to guide decision-making regarding land-use at all levels of planning. The SPCs represent a classification system that indicates the most suitable, or a range of, land-use options for a certain piece of land. Associated with each SPC category is land-use guidelines which when implemented ensures a balance between development and conservation. Mainstreaming of the biodiversity plan into spatial planning process will be achieved by aligning the biodiversity plan categories with those of the SPCs so that planning according to SPC will then automatically also adopt the biodiversity plan categories and their associated land-use guidelines. Various biodiversity layers were overlaid to the study area and used to determine the sensitivity and/or certain requirements thereof. The results are provided in in subsequent sections of the report.

4.2.4 IFC PERFORMANCE STANDARDS

The International Finance Corporation (IFC) is an international financial institution that offers investment, advisory, and asset management services to encourage private sector development in developing countries. The IFC is a member of the World Bank Group (WBG) and is headquartered in Washington, D.C., United States. It was established in 1956 as the private sector arm of the WBG to advance economic development by investing in strictly for-profit and commercial projects that purport to reduce poverty and promote development.

The IFC's stated aim is to create opportunities for people to escape poverty and achieve better living standards by mobilizing financial resources for private enterprise, promoting accessible and competitive markets, supporting businesses and other private sector entities, and creating jobs and delivering necessary services to those who are poverty-stricken or otherwise vulnerable. Since 2009, the IFC has focused on a set of development goals that supported projects are expected to target. Its goals are to increase sustainable agriculture opportunities, improve health and education, increase access to financing for microfinance and business clients, advance infrastructure, help small businesses grow revenues, and invest in climate health.

The IFC is owned and governed by its member countries but has its own executive leadership and staff that conduct its normal business operations. It is a corporation whose shareholders are member governments that provide paid-in capital, and which have the right to vote on its matters. Originally more financially integrated with the WBG, the IFC was established separately and eventually became authorized to operate as a financially autonomous entity and make independent investment decisions. It offers an array of debt and equity financing services and helps companies face their risk exposures, while refraining from participating in a management capacity. The corporation also offers advice to companies on making decisions, evaluating their impact on the environment and society, and being responsible. It advises governments on building infrastructure and partnerships to further support private sector development.

The IFC’s Sustainability Framework articulates the Corporation’s strategic commitment to sustainable development and is an integral part of IFC’s approach to risk management. The Sustainability Framework comprises IFC’s Policy and Performance Standards on Environmental and Social Sustainability, and IFC’s Access to Information Policy. The Policy on Environmental and Social Sustainability describes IFC’s commitments, roles, and responsibilities related to environmental and social sustainability. IFC’s Access to Information Policy reflects IFC’s commitment to transparency and good governance on its operations and outlines the Corporation’s institutional disclosure obligations regarding its investment and advisory services. The Performance Standards (PSs) are directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of its direct investments (including project and corporate finance provided through financial intermediaries), IFC

requires its clients to apply the PSs to manage environmental and social risks and impacts so that development opportunities are enhanced. IFC uses the Sustainability Framework along with other strategies, policies, and initiatives to direct the business activities of the Corporation to achieve its overall development objectives. The PSs are often also applied by other financial institutions and therefore these PSs are discussed in Table 10 in terms of the applicability of the various PSs to this Seismic Survey and the activities associated with it.

Table 10: IFC Performance Standards applicability to this project.

<table>
<tr><th colspan="4">Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts</th></tr>
<tr><td>Overview</td><td colspan="3">Performance Standard 1 (PS1) underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders.</td></tr>
<tr><td>Objectives</td><td colspan="3">➢ To identify and evaluate environmental and social risks and impacts of the project.
➢ To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment.
➢ To promote improved environmental and social performance of clients through the effective use of management systems.
➢ To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately.
➢ To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.</td></tr>
<tr><td rowspan="8">Aspects</td><td>1.1</td><td>• Policy</td><td rowspan="8"><u>Consideration of PS1 to this project:</u>
The South African NEMA EIA Regulations are specifically geared towards ensuring that a projects environmental and social risks and impacts are identified and assessed in order to put forward suitable impact management actions and outcomes for final decision making by the Competent Authority.
This BA Report includes a detailed assessment of this PSs aspects relating to environmental and social risks and impacts and the culmination of an EMPr containing the relevant mitigation measures which are aimed at limiting the final significance of each identified impact. Throughout the BA process, stakeholder engagement has been undertaken to solicit input from I&APs and ongoing stakeholder engagement and communication will be ongoing during the lifecycle of the project.</td></tr>
<tr><td>1.2</td><td>• Identification of Risks and Impacts</td></tr>
<tr><td>1.3</td><td>• Management Programmes</td></tr>
<tr><td>1.4</td><td>• Organisational Capacity and Competency</td></tr>
<tr><td>1.5</td><td>• Emergency Preparedness and Response</td></tr>
<tr><td>1.6</td><td>• Monitoring and Review</td></tr>
<tr><td>1.7</td><td>• Stakeholder Engagement</td></tr>
<tr><td>1.8</td><td>• External Communication and</td></tr>
</table>

		Grievance Mechanism	
	1.9	• Ongoing Reporting to Affected Communities	
Performance Standard 2: Labour and Working Conditions;			
Overview	Performance Standard 2 (PS2) recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers.		
Objectives	➢ To promote the fair treatment, non-discrimination, and equal opportunity of workers. ➢ To establish, maintain, and improve the worker-management relationship. ➢ To promote compliance with national employment and labour laws. ➢ To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain. ➢ To promote safe and healthy working conditions, and the health of workers. ➢ To avoid the use of forced labour.		
Aspects	2.1	• Working Conditions and Management of Worker Relationship • Human Resources Policy and Management • Working Conditions and terms of Engagement • Workers organisation • Non- Discrimination and Equal Opportunity • Retrenchment • Grievance Mechanism	**<u>Consideration of PS2 to this project:</u>** This project will require a number of temporary as well as permanent workers during the variou sphases of the exploration activities. In terms of South African labour legislation (OHSA/MHSA), it will be obligatory on Tetra4 and all sub-contractors to ensure that workers operate in a safe working environment and that employment contracts are fair and reasonable.
	2.2	• Protecting the Workforce • Child Labour • Forced Labour	
	2.3	• Occupational health and Safety	
	2.4	• Workers Engaged by Third Parties	

	2.5	• Supply Chain	
Performance Standard 3: Resource Efficiency and Pollution Prevention			
Overview	Performance Standard 3 (PS3) recognises that increased economic activity and urbanisation often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use and pollution prevention and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world.		
Objectives	➢ To avoid or minimise adverse impacts on human health and the environment by avoiding or minimising pollution from project activities. ➢ To promote more sustainable use of resources, including energy and water. ➢ To reduce project related GHG emissions.		
Aspects	3.1	• Policy Resource Efficiency • Greenhouse Gases • Water Consumption	**<u>Consideration of PS3 to this project:</u>** The various pollution sources and associated impacts of this project have been identifieid in this BA. Surface and groundwater pollution during seismic operations will be prevented through mitigation measures set out in this report. Various procedures and plans will be put in place which put forward management actions for general and hazardous waste, pesticide use and management, etc.
	3.2	• Pollution Prevention • Air Emissions • Stormwater • Waste Management • Hazardous Materials Management • Pesticide use and Management	
Performance Standard 4: Community Health, Safety, and Security			
Overview	Performance Standard 4 (PS4) recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.		
Objectives	➢ To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances. ➢ To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimises risks to the Affected Communities.		
Aspects	4.1	• Community Health and Safety • Infrastructure and Equipment Design and Safety	**<u>Consideration of PS4 to this project:</u>** The aspects included in this PS are considered in this project BA and mitigation measures included in the EMPr.

		• Hazardous Materials Management and Safety • Ecosystem Services • Community Exposure to Disease • Emergency Preparedness and Response	The following conditions have been included in the recommendationed conditions of authorisation to ensure that community health and safety is specifically considered: • All workers must be educated on the need to ensure safety of surrounding communities and the public in general. Road safety legislation must be complied with at all times with additional consideration of the World Bank Group Environmental Health and Safety Guidelines. A community health and safety plan inclusive of a Traffic Management Plan will be developed based on risks identified in consideration of community health and safety. • Risks associated with the potential use of security personnel will be assessed prior to operations and a security management plan will be developed if required and in accordance with IFC PS4.
	4.2	• Security Personnel	
Performance Standard 5: Land Acquisition and Involuntary Resettlement			
Overview	Performance Standard 5 (PS5) recognises that project-related land acquisition and restrictions on land-use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land-use.		
Objectives	➢ To avoid, and when avoidance is not possible, minimise displacement by exploring alternative project designs. ➢ To avoid forced eviction. ➢ To anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land-use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. ➢ To improve, or restore, the livelihoods and standards of living of displaced persons. ➢ To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.		
Aspects	5.1	• Displacement • Physical Displacement • Economic Displacement • Private Sector Responsibilities under Government Managed Resettlement	**<u>Consideration of PS5 to this project:</u>** Due to the nature of this seismic project, the proposed exploration activities will impact existing land-users (mainly farmlands as well as lawful occupiers of land including host communities). Socio-economic sensitivities within the proposed development areas have been identified (such as noise, visual, land-use, etc.) as a primary means of avoidance however the final route of the vibroseis truck and timeline will be negotiated with affected parties to ensure minimal impact on existing land-use. Tetra4 has compiled a Stakeholder Engagement Procedure (Document Ref: T4-PP-SHERQ-048). The intention of this procedure is to stipulate measures for effective engagement and the recording of engagement with relevant stakeholders.

			This document is applicable to all parties undertaking Works as or on behalf of Tetra4 within the Virginia Production Right area. The document highlights the requirements of all parties with regards to stakeholder engagement, the establishment and maintenance of good working relationships and recording of stakeholder interactions during any Works undertaken. In addition, a contractual document (Access Use and Servitude Agreement) is shared with affected stakeholders for negotiation prior to commencement with the exploration activities, including but not limited to the construction phase. Agreements are reached with affected parties in terms of suitable compensation (per hectare per year) during the construction, operational and decommissioning phases of the exploration project.
Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources			
Overview	Performance Standard 6 (PS6) recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development.		
Objectives	➢ To protect and conserve biodiversity. ➢ To maintain the benefits from ecosystem services. ➢ To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.		
Aspects	6.1	• Protection and Conservation of Biodiversity	**<u>Consideration of PS6 to this project:</u>** Due to the extensive spatial distribution of the project infrastructure, various sensitive environmental features occur within the proposed project footprint and include CBAs, ESAs, rivers, wetlands, indigenous vegetation, etc. Specialist assessments have been undertaken to identify and assess the projects impact on sensitive biodiversity areas and include a Biodiversity Impact Assessment and Wetland and Aquatic Impact Assessment. Various levels of mitigation are put forward by the specialist studies based on the sensitivity of the receiving environment. Alien and invasive species will be controlled throughout the lifecycle of the project through the implementation of the Declared Weeds and Invasive Alien Plant Management Procedure (Document Ref: T4-PP-SHERQ-038).
Performance Standard 7: Indigenous People			
Overview	Performance Standard 7 (PS7) recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded.		

<table>
<tr><td>Objectives</td><td colspan="3">

To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples.
To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts.
To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner.
To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle.
To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present.
To respect and preserve the culture, knowledge, and practices of Indigenous Peoples.

</td></tr>
<tr><td rowspan="4">Aspects</td><td>7.1</td><td>• General
• Avoidance of Adverse Impacts
• Participation and Consent</td><td rowspan="4"><u>Consideration of PS7 to this project:</u>
As per IFC Guidance Note 7, in this Performance Standard, the term "Indigenous Peoples" is used in a generic sense to refer to a distinct social and cultural group possessing the following characteristics in varying degrees:
• Self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
• Collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
• Customary cultural, economic, social, or political institutions that are separate from those of the mainstream society or culture; or
• A distinct language or dialect, often different from the official language or languages of the country or region in which they reside.
With due consideration of the above accepted definition in IFC Guidance Note 7 and as per the international instruments under the United Nations (UN) Human Rights Conventions, no indigenous peoples are present within the study area and therefore PS7 is not triggered by this proposed development and no further assessment in this regard is required.</td></tr>
<tr><td>7.2</td><td>• Circumstances Requiring Free, Prior, and Informed Consent
• Impacts on Lands and Natural Resources Subject to Traditional Ownership or Under Customary Use
• Critical Cultural Heritage
• Relocation of Indigenous Peoples from Lands and Natural Resources Subject to Traditional Ownership or Under Customary Use</td></tr>
<tr><td>7.3</td><td>• Mitigation and Development Benefits</td></tr>
<tr><td>7.4</td><td>• Private Sector Responsibilities Where Government is Responsible for Managing</td></tr>
</table>

		Indigenous Peoples Issues	
Performance Standard 8: Cultural Heritage			
Overview	Performance Standard 8 (PS8) recognizes the importance of cultural heritage for current and future generations.		
Objectives	➢ To protect cultural heritage from the adverse impacts of project activities and support its preservation. ➢ To promote the equitable sharing of benefits from the use of cultural heritage.		
Aspects	8.1	• Protection of Cultural Heritage in Project Design and Execution	**Consideration of PS8 to this project:** A detailed Heritage Impact Assessment as well as a Palaeontological Impact Assessment have been undertaken by suitably qualified specialists. Various cultural heritage resources have been identified within the study area and specific mitigation measures for each (depending on significance) put forward. Chance Finds and Heritage Protection Procedure (Document Ref: T4-PP-SHERQ-037) has been prepared by Tetra4 for implementation by relevant project role-players.

4.2.5 WORLD BANK (WB) AND INTERNATIONAL FINANCE CORPORATION (IFC) GUIDELINES

4.2.5.1 WORLD BANK EHS GUIDELINES FOR ONSHORE OIL AND GAS DEVELOPMENT

The EHS Guidelines for Onshore Oil and Gas Development include information relevant to exploration and decommissioning. Key issues identified for onshore gas developments related to environmental issues and occupational health and safety issues, and community health and safety issues (World Bank, 2007).

Potential environmental issues associated with onshore gas development projects include the following:

- Air emissions;
- Wastewater discharges;
- Solid and liquid waste management;
- Noise generation;
- Terrestrial impacts and project footprint;
- Impacts on subsoil and aquifers;
- Spills; and

In addition to the typical OHS issues of large industrial activities, the following additional issues relate to onshore gas development projects:

- Asset Integrity Management;
- Fire and explosion;
- Air quality;
- Hazardous materials;
- Transportation;

- Well blowouts; and

Community health and safety impacts during the construction, exploration (operation) and decommissioning of onshore gas developments include:

- Physical hazards;
- Exposure to emissions;
- Security; and
- Impacts on land-use.

4.2.5.2 IFC ENVIRONMENTAL NOISE GUIDELINE

The IFC General Environmental Health and Safety Guidelines on noise address impacts of noise beyond the property boundary of the facility under consideration and provides noise level guidelines. The IFC states that noise impacts should not exceed the levels presented in Table 11, or result in a maximum increase above background levels of 3 dBA at the nearest receptor location off-site (IFC, 2020). For a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level is not detectable. Δ = 3 dBA is therefore a useful significance indicator for a noise impact.

It is further important to note that the IFC noise level guidelines for residential, institutional and educational receptors correspond with the SANS 10103 guidelines for urban districts.

Table 11: IFC noise level guidelines.

Area	One Hour LAeq (dBA) 07:00 to 22:00	One Hour LAeq (dBA) 22:00 to 07:00
Industrial receptors	70	70
Residential, institutional and educational receptors	55	45

4.2.6 GHG AND CLIMATE CHANGE

Greenhouse Gasses (GHG) are defined as “Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of radiation emitted by the Earth’s surface, by the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4) and ozone (O3) are the primary GHGs in the Earth’s atmosphere. Human-made GHGs include sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs), chlorofluorocarbons (CFCs) and perfluorocarbons (PFCs); several of these are also O3-depleting and are regulated under the Montreal Protocol” (IPPC, 2024). Beside CO_2, N_2O and CH_4, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) (UNCC, 1997). Since the onset of industrialization in the eighteenth century, anthropogenic activities have elevated atmospheric carbon dioxide concentrations by 50 %. Consequently, current CO_2 levels are 150 % of pre-industrial values. The amount of CO2 has increased from 365 ppm in 2002 to over 420 ppm in 2024 (Figure 8). This human-induced increase surpasses the natural rise observed at the conclusion of the last ice age, approximately twenty thousand years ago (NASA, 2024). This increase has occurred despite the uptake of a large portion of the emissions by various natural "sinks" involved in the carbon cycle (NASA, 2024). The naturally occurring gas, CO2 is also a byproduct of the combustion of fossil fuels (oil, gas, and coal), biomass burning, and various industrial processes, including land-use changes (IPCC, 2007).

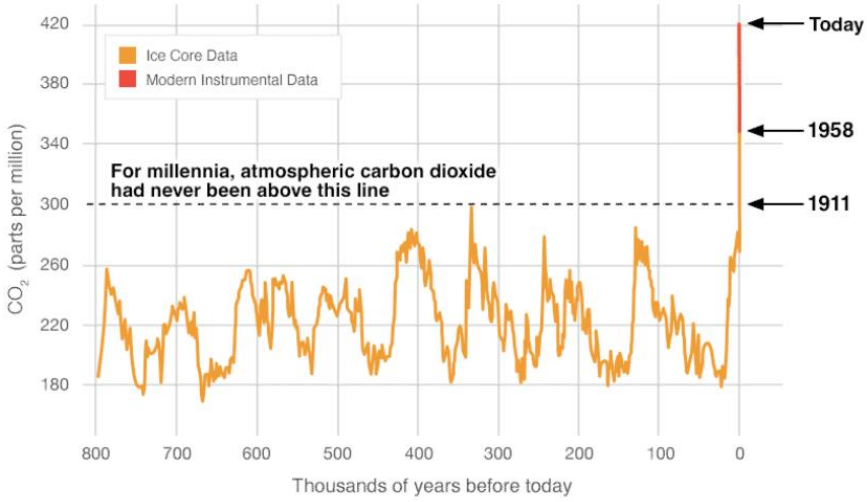


Figure 8: Historical changes in global carbon dioxide over time, (NASA, 2024).

The International Finance Corporation (IFC) lists methods that countries and projects can reduce GHG impacts. These include carbon financing; improvement of energy efficiency; GHG sinks and reservoir protection and improvements; that environmentally friendly agriculture and forestry be encouraged; the increased use of renewable energy methods; implementation of carbon capture and sequestration methods; and improved waste management (recovery and use of methane emissions) as well as reducing GHG emissions from vehicle use and industrial, construction and energy production processes (IFC, 2007). Carbon financing may have much potential in developing countries as well as sustainable agriculture and forestry practices, and when supported by governments may be a way of reducing the country's GHG impacts, where projects receive carbon credits and financing for reducing GHG emissions and installing more environmentally friendly alternatives (IFC, 2007). Because different industries contribute various amounts of GHG emissions, the IFC performance standards states that projects anticipated to generate or currently producing carbon dioxide equivalent emissions exceeding 25,000 tonnes annually will necessitate the quantification of direct emissions originating from facilities owned or controlled within the project boundary. Additionally, indirect emissions associated with off-site energy consumption must be quantified. The client will conduct annual greenhouse gas emissions quantification aligned with internationally recognized methodologies and best practices (IFC, 2012).

4.2.6.1 INTERNATIONAL AGREEMENTS

In 1992, countries joined an international treaty, the United Nations Framework Convention on Climate Change (UN, 1992) as a framework for international cooperation to combat climate change by limiting average global temperature increases and the resulting climate change, and coping with impacts that were, by then, inevitable.

By 1995, countries launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol (UNCC, 1997). The Kyoto Protocol legally binds developed country parties to emission reduction targets. The Protocol's first commitment period started in 2008 and ended in 2012. As agreed in Doha in 2012, the second commitment period began on 1 January 2013 and would end in 2020 (UN, 2017) but due to lack of ratification has not come into force.

The Paris Agreement was adopted by 196 Parties at Conference of the Parties (COP21) in Paris, on 12 December 2015 and commenced 4 November 2016 (UN, 2015). The Paris Agreement (2016) builds upon the Convention and – for the first time – brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate

financial flows, a new technology framework and an enhanced capacity building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives.

The Paris Agreement is founded on the idea of countries improving on their climate change strategies in 5-year cycles. The Paris Agreement requires all Parties to put forward their best efforts through "nationally determined contributions" (NDCs) and to strengthen these efforts in the years ahead. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts. The Paris Agreement proposes that Parties submit long-term low greenhouse gas emission development strategies (LT-LEDS) by 2020 but this was not mandatory.

Parties will take stock of the collective efforts in relation to progress towards the goal set in the Paris Agreement and to inform the preparation of NDCs. There will also be a global stocktake every 5 years to assess the collective progress towards achieving the purpose of the Agreement and to inform further individual actions by Parties. Ethiopia submitted their first NDC to the UNFCCC secretariat and ratified the Paris agreement on 9 March 2017. Existing Parties were expected to submit their updated NDC in 2020; and new Parties their original NDCs. Parties are to submit updated NDCs every 5 years. As of May 2021, there are 192 parties that have submitted their NDCs and 8 parties that have submitted their second NDC. There are only 191 Parties to the Paris Agreement; Eritrea has not become a Party to the Paris Agreement but has submitted its first NDC.

Countries as part of the Paris agreement established an enhanced transparency framework (ETF). ETF is to start in 2024 and all countries will need to openly report on all activities untaken and progress in climate change mitigation, adaptation measures as well as any support provided or received. ETF also sets out a procedure for reviewing submitted reports. The information provided as part of the ETF will be used as an input for the global stocktake which will assess the collective progress towards the long-term climate goals.

4.2.6.2 GLOBAL GHG EMISSION INVENTORY

The proposed Tetra4 exploration activities would most likely fall under the category of "energy" for the global GHG inventory. According to the "mitigation of climate change" document as part of the Intergovernmental Panel on Climate Change (IPCC) fifth Assessment Report (AR5) the 2010 global GHG emissions were 49 (±4.5) Gt CO_2-e, of which 35% (17 Gt CO_2-e) was a result of the energy sector (IPCC, 2014). The World Resources Institute Climate Watch global GHG emissions from the "industrial processes" sector were 2.7711 Gt CO_2-e in 2016 (6% of total anthropogenic GHG emissions).

4.2.6.3 SOUTH AFRICA'S STATUS IN TERMS OF CLIMATE CHANGE AND QUANTIFICATION OF GREENHOUSE GASES

4.2.6.3.1 PARIS AGREEMENT - NATIONALLY DETERMINED CONTRIBUTION

South Africa ratified the UNFCCC in August 1997 and acceded to the Kyoto protocol in 2002, with effect from 2005. However, since South Africa is an Annex 1 country it implies no binding commitment to cap or reduce GHG emissions. The South African Intended Nationally Determined Contribution (INDC) was completed in 2015 and submitted to the UNFCCC on 1 November 2016. This was undertaken to comply with decision 1/CP.19 and 1/CP.20 of the Conference of the Parties to the UNFCC. This document describes South Africa's INDC on adaptation, mitigation and finance and investment necessities to undertake the resolutions.

As part of the adaption portion the following goals have been assembled:

1. Goal 1: Development and implementation of a National Adaption Plan. The implementation of this will also result in the implementation of the National Climate Change Response Plan (NCCRP) per the 2011 policy.
2. Goal 2: In the development of national, sub-national and sector strategy framework, climate concerns must be taken into consideration.
3. Goal 3: An official institutional function for climate change response planning and implementation needs to be assembled.
4. Goal 4: The creation of an early warning, vulnerability, and adaptation monitoring system

5. Goal 5: Develop policy regarding vulnerability assessment and adaptation needs.
6. Goal 6: Disclosure of undertakings and costs with regards to past adaptation strategies.

As part of the mitigation portion the following have been, or can be, implemented at National level:

- The approval of 79 (5 243 MW) renewable energy Independent Power Producer (IPP) projects as part of a Renewable Energy Independent Power Producer Procurement Programme (REI4P). An additional 6 300 MW is being deliberated.
- A "Green Climate Fund" has been created to back green economy initiatives. This fund will be increased in the future to sustain and improve successful initiatives.
- It is intended that by 2050 electricity will be decarbonised.
- Carbon Capture and Sequestration (or Carbon Capture and Storage) (CCS).
- To support the use of electric and hybrid electric vehicles.
- Reduction of emissions can be achieved through the use of energy efficient lighting; variable speed drives and efficient motors; energy efficient appliances; solar water heaters; electric and hybrid electric vehicles; solar photovoltaic; wind power; CCS; and advanced bioenergy.

A draft update of the first NDC was published for public comment on the 30th of March 2021 and the final updated of the first NDC was published and submitted to the UNFCCC on the 27th of September 2021 in preparation for the 26th Conference of the Parties (to held in Glasgow, Scotland in November 2021). The final update of the first NDC South Africa has not submitted its second NDC to UNFCCC. The draft document describes South Africa's NDC on adaptation, mitigation and finance and investment necessities to undertake the resolutions with updated revisions to the adaptation goals and mitigation targets.

As part of the updated adaption portion the following goals have been assembled:

1. Goal 1: Enhance climate change adaptation governance and legal framework.
2. Goal 2: Develop an understanding of the impacts on South Africa of 1.5 and 2°C global warming and the underlying global emission pathways through geo-spatial mapping of the physical climate hazards, and adaptation needs in the context of strengthening the key sectors of the economy. This will provide the scientific basis for strengthening the national and provincial governments' readiness to respond to climate risk.
3. Goal 3: Implementation of National Climate Change Adaptation Strategy (NCCAS) adaptation interventions for the period 2021 to 2030, where priority sectors have been identified as biodiversity and ecosystems; water; health; energy; settlements (coastal, urban, rural); disaster risk reduction, transport infrastructure, mining, fisheries, forestry and agriculture.
4. Goal 4: Mobilise funding for adaptation implementation through multilateral funding mechanisms.
5. Goal 5: Quantification and acknowledgement of the national adaptation and resilience efforts.

As part of the mitigation portion the following have been, or can be, implemented at National level:

- The approval of 79 (5 243 MW) renewable energy Independent Power Producer projects as part of a Renewable Energy Independent Power Producer Procurement Programme. An additional 6 300 MW is being deliberated.
- A "Green Climate Fund" has been created to back green economy initiatives. This fund will be increased in the future to sustain and improve successful initiatives.
- It is intended that by 2050 electricity will be decarbonised.
- CCS.

- To support the use of electric and hybrid electric vehicles.
- Reduction of emissions can be achieved through the use of energy efficient lighting; variable speed drives and efficient motors; energy efficient appliances; solar water heaters; electric and hybrid electric vehicles; solar photovoltaic (PV); wind power; CCS; and advanced bioenergy.
- Updated targets based on revised 100-year global warming potential (GWP) factors (published in the Annex to decision 18/CMA.1 of the IPCC 5th assessment report) and based on exclusion of land sector emissions arising from natural disturbance. The updated NDC mitigation targets, consistent with South Africa's fair share, are presented in Table 12.

Table 12: South Africa's NCD mitigation targets.

Year	Target	Corresponding period
2025	South Africa's annual GHG emissions will be in a range between 398 - 510 Mt CO_2-e.	2021-2025
2030	South Africa's annual GHG emissions will be in a range between 398 - 440 Mt CO_2-e.	2026-2030

4.2.6.3.2 NATIONAL CLIMATE CHANGE RESPONSE POLICY

The National Climate Change Response White Paper stated that in responding to climate change, South Africa has two objectives: to manage the inevitable climate change impacts and to contribute to the global effort in stabilising GHG emissions at a level that avoids dangerous anthropogenic interference with the climate system. The White Paper proposes mitigation actions, especially a departure from coal-intensive electricity generation, be implemented in the short- and medium-term to match the GHG trajectory range. Peak GHG emissions are expected between 2020 and 2025 before a decade long plateau period and subsequent reductions in GHG emissions.

The White Paper also highlighted the co-benefit of reducing GHG emissions by improving air quality and reducing respiratory diseases by reducing ambient particulate matter, ozone and SO_2 concentrations to levels in compliance with NAAQS by 2020.

In order to achieve these objectives, the Department of Forestry, Fisheries and Environment (DFFE) has appointed a service provider to establish a national GHG emissions inventory, which will report through SAAQIS.

The draft Climate Change Bill was published for comment on the 8th of June 2018 and introduced to parliament on the 18th of February 2022 (B9-2022). The Bill has since been signed into law as the Climate Change Act on the 23rd of July 2024. The Act is aligned with international policies guidelines and South Africa's Nationally Determined Contribution and aim to reduce GHG emissions as primary driver to anthropogenic climate change. The aim of the Bill is to achieve an effective climate change response through a long-term just transition to a low carbon economy that is climate resilient and allows for sustainable development of South Africa. The Act ensures that:

- Provincial and municipal forums are established on climate change which will be responsible for coordinating climate change response actions in each province.
- The establishment of the Presidential Climate Change Coordinating Commission (4PC) is strengthened. The 4PC has already been established and has been working for the Government since December 2020 and is legally required now.
- Within one year of the Act coming into force, a National Adaptation Strategy is established. This strategy will guide South Africa's adaptation to the impacts of climate change and develop adaptation scenarios which anticipate the likely impacts over the short, medium, and long term.

- A national GHG emissions trajectory is determined, which must be reviewed every five years, and which indicates an emissions reduction objective.
- A 5-yearly sectoral emission targets is put in place for identified sectors and sub-sectors. The sectoral targets must be aligned with the national GHG emissions trajectory and include quantitative and qualitative GHG emission reduction goals.
- The carbon budget allocation mechanism is brought into force, which will replace the current National Pollution Prevention Plan mechanism which is enforced under the National Environmental Management: Air Quality Act (NEM:AQA). The carbon budget will be linked to the Carbon Tax Act, in relation to carbon tax rates which will be charged on emissions above the carbon budget.

Seismic activities often necessitate the development of new infrastructure, such as roads. The construction and operational phases of these facilities can result in greenhouse gas emissions, thereby subjecting the project to the provisions of the Climate Change Act. Furthermore, the subsequent extraction and utilization of the explored resource, such as natural gas, may contribute to greenhouse gas emissions, necessitating compliance with the Act's regulations. While seismics itself does not directly trigger the Act's application, the associated activities and potential environmental impacts may bring the project within its scope.

4.2.6.3.3 GREENHOUSE GAS EMISSIONS REPORTING

Regulations pertaining to GHG reporting using the National Atmospheric Emissions Inventory System (NAEIS) were published in 2017 (Republic of South Africa, 2017) (as amended by GN R994, 11 September 2020). The South African mandatory reporting guidelines focus on the reporting of Scope 1 emissions only.

The South African Greenhouse Gas Emission Reporting System (SAGERS) web-based monitoring and reporting system will be used to collect GHG information in a standard format for comparison and analyses. The system forms part of the national atmospheric emission inventory component of South African Atmospheric Emission Licensing and Inventory Portal (SAAELIP). Tetra4 operations will have to report their GHG emissions to SAGERS since there is no threshold for annual GHG emissions reporting for the Natural Gas producers as per the amended GHG reporting guidelines (GG43712, 7 September 2020).

The DFFE is working together with local sectors to develop country specific emissions factors in certain areas; however, in the interim the IPCC default emission figures may be used to populate the SAAQIS GHG emission factor database. These country specific emission factors will replace some of the default IPCC emission factors. Technical guidelines for GHG emission estimation have been issued.

4.2.6.3.4 NATIONAL GHG EMISSIONS INVENTORY

South Africa is perceived as a global climate change contributor and is undertaking steps to mitigate and adapt to the changing climate. DFFE is categorised as the lead climate change institution and is required to coordinate and manage climate related information such as development of mitigation, monitoring, adaption, and evaluation strategies (DEA, 2019). This includes the establishment and updating of the National GHG Inventory. The National Greenhouse Gas Improvement Programme (GHGIP) has been initiated; it includes sector specific targets to improve methodology and emission factors used for the different sectors as well as the availability of data.

The 2000 to 2017 National GHG Inventory was prepared using the 2006 IPCC Guidelines (IPCC, 2006) based on updated sector information and emission estimation techniques. According to the 4th Biennial Update Report to the UNFCCC (DFFE, 2021), the total GHG emissions in 2017 were estimated at approximately 512.14 million metric tonnes CO_2-e (excluding Forestry and Other Land-use [FOLU]). This was a 14.2% increase from the 2000 total GHG emissions (excluding FOLU) and 2.8% decrease from the 2015 total GHG emissions (excluding FOLU). FOLU is estimated to be a net carbon sink which reduces the 2017 GHG emissions to 482.02 million metric tonnes CO_2-e. The estimated GHG emissions (excluding FOLU) for 2017 showed the Industrial Processes and Product Use (IPPU) sector contributed 6.3% to the total GHG emissions (excluding FOLU). The estimated CO_2-e emissions (excluding FOLU) for 2017 for the IPPU sector is 32.08 million metric tonnes.

By integrating the exploration rights, Tetra4 will gain access to potentially new helium reserves adjacent to their current production zone. This bolsters their helium resource base and extends the lifespan of the existing production right, ensuring a more sustainable and long-term helium production capability. Integrating exploration rights into the production right simplifies operational logistics and reduces administrative burdens. Managing exploration and production activities under a single right, streamlines processes and potentially reduces administrative costs associated with maintaining separate exploration rights.

Expanding helium exploration within a contiguous area minimizes the overall environmental footprint associated with exploration activities. This avoids the need to establish entirely new exploration zones, potentially reducing land disturbance and associated environmental impacts. Helium is a critical resource with a wide range of irreplaceable applications in science, medicine, and technology. Global demand for helium is projected to rise steadily, driven by its essential role in sectors like MRI machines, semiconductors, and space exploration. By incorporating these exploration rights, Tetra4 position themselves to contribute to a stable and reliable supply of helium to meet this growing demand.

This project aligns with principles of responsible resource management. Integrating seismics to the exploration programme allows for a more comprehensive understanding of the helium resource potential within a defined area. This facilitates the development of a long-term production plan that maximises resource recovery while minimising environmental impact.

Undertaking a seismic survey as part of the exploration activities presents a strategic and responsible approach to helium resource development. This project offers significant benefits for extending production life, streamlining operations, and contributing to a sustainable helium supply. By implementing this project, Tetra4 will be able to foster economic development, social upliftment, and environmental responsibility within South Africa, particularly in the Free State Province.

4.2.7 LEJWELEPUTSWA INTEGRATED DEVELOPMENT PLAN (IDP)

The Integrated Development Plan (IDP) 2017-2022 for the Lejweleputswa District Municipality serves as a strategic blueprint focused on reversing the economic decline of a region historically dependent on gold mining. The report highlights that while the mining sector still contributes nearly half of the district's Gross Value Added (GVA), it has faced a steady downturn, resulting in an unemployment rate of 36.5%, the highest in the Free State. To combat this, the IDP emphasizes Local Economic Development (LED) and the prioritization of investment in high-potential "Economic Nodes" like Welkom. The municipality's vision is to leverage its existing infrastructure to foster sustainable growth, with a particular focus on creating opportunities for its large, energetic youth population that currently faces high levels of emigration due to a lack of local jobs.

The proposed seismic exploration for helium and methane gas fits directly into the IDP's core objective of diversifying the regional economy and "harnessing new mining potential." Since the plan explicitly seeks to minimize the impact of declining gold production, the discovery of alternative natural resources represents a vital lifeline for the district's industrial future. By exploring for gas near Welkom—a town classified in the Spatial Development Framework as having "Very High" growth potential—the project aligns with the district's goal of directing fixed investment toward established urban centers. This ensures that the exploration phase and any subsequent extraction can benefit from existing logistical networks and specialized services centered in the Matjhabeng area.

Furthermore, the project supports the IDP's social mandates regarding poverty alleviation and job creation. The district is currently grappling with the social fallout of mining retrenchments, and a new extractive industry could provide the necessary stimulus to revitalize the manufacturing and heavy industry sectors, which have slumped alongside the gold mines. Because the IDP is premised on facilitating external investment through the Lejweleputswa Development Agency, this project acts as a catalyst for the "vibrant economy" the municipality aims to build. Ultimately, the exploration aligns with the district's strategic move toward becoming a diversified energy and commercial hub, rather than a single-commodity mining region.

4.2.7.1 MASILONYANA LOCAL MUNICIPALITY IDP

The Masilonyana Local Municipality Integrated Development Plan (IDP) 2019/2020 is a strategic framework designed to guide the municipality toward becoming an integrated, developmental, and viable institution. Its core mission centers on effective and transparent governance to promote economic development, provide sustainable services, and improve the overall quality of life for its residents. The municipality's economy is historically dependent on agriculture and mining, but with the mining sector in a state of decline, the IDP prioritizes finding new avenues for economic growth and infrastructure expansion. Key strategic goals include providing sustainable community services and promoting a sound environmental management system. The proposed seismic exploration for helium and methane gas fits directly into the IDP's focus on Local Economic Development (LED) and job creation. Because the municipality is grappling with high unemployment—with Masilonyana having the highest youth unemployment rate in the Lejweleputswa District at 38.8%—the introduction of a new energy-focused extractive industry offers a significant opportunity to revitalize the local economy. The project aligns with the IDP's mandate to "harness existing mining potential" while diversifying away from the declining traditional mining sector. Furthermore, such an exploration project contributes to the municipality's 30-year development plan, which emphasizes infrastructure development as a primary driver for long-term sustainability and poverty reduction. Additionally, the exploration project supports the municipality's goal of fostering spatial integration and inclusive growth. By investing in specialized industrial activities near Welkom, the project leverages the region's existing status as a service and administrative center. The IDP explicitly calls for the promotion of social and economic development through expanded infrastructure and the transformation of urban and rural spaces. Successful exploration could provide the groundwork for future energy security and manufacturing opportunities, directly supporting the municipality's vision of creating a safe, harmonious, and investor-friendly environment.

4.2.7.2 MATJHABENG LOCAL MUNICIPALITY IDP

The Matjhabeng Local Municipality Integrated Development Plan (IDP) 2022/2023 serves as the primary strategic instrument to guide development and resource allocation within the municipality, which includes the town of Welkom. The municipality’s vision is to become a "benchmark developmental municipality in service delivery excellence" through a paradigm shift in governance that emphasizes transparency, inclusive growth, and the redress of past spatial injustices. The IDP identifies six Key Performance Areas (KPAs), focusing heavily on basic service delivery, financial management, and local economic development (LED). A critical component of the report is the situational analysis, which reveals that while Matjhabeng remains the hub of mining activity in the Free State, the sector has been on a downward trend due to high production costs, leading to significant unemployment and poverty in the region.

The proposed seismic exploration for helium (He) and methane gas aligns with the IDP’s strategic objectives, particularly the goal of revitalizing a declining economy through diversification. The IDP explicitly states that alternatives to the traditional mining sector—specifically gas and renewable energy—must be explored to mitigate the economic impact of shaft closures and lower commodity prices. By targeting helium and methane, this project directly supports the municipality’s "Mayoral Strategic Priority" for increased investment in economic infrastructure and the creation of a conducive environment for growth. Furthermore, because the IDP identifies a young population with high unemployment, a new extractive industry could provide much-needed job creation and skills development, which are central to the municipality’s "Local Economic Development" KPA.

The exploration also fits into the municipality’s emerging focus on climate change and the green economy. The IDP includes strategic goals for developing a climate change strategy and moving toward a "Climate Resilient Municipality". Helium and methane exploration represents a transition toward different energy resources that could foster a "vibrant local economy" while aligning with provincial and national growth strategies mentioned in the report, such as the Free State Growth and Development Strategy. Spatially, the project leverages Welkom's status as a central industrial hub, utilizing its existing logistical networks and specialized commercial services to drive the "economic corridors" intended to link the district's towns.

5 NEED AND DESIRABILITY OF PROPOSED PROJECT

The need and desirability analysis component of the "Guideline on need and desirability in terms of the Environmental Impact EIA Regulations (Notice 819 of 2014)" includes, but is not limited to, describing the linkages and dependencies between human well-being, livelihoods and ecosystem services applicable to the area in question, and how the proposed activity's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage sites, opportunity costs, etc.). Table 13 below presents the need and desirability analysis undertaken for the proposed seismic exploration activity.

Table 13: Need and desirability of the proposed project.

Ref No.	Question	Answer
1	Securing ecological sustainable development and use of natural resources	
1.1	How were the ecological integrity considerations taken into account in terms of: Threatened Ecosystems, Sensitive and vulnerable ecosystems, Critical Biodiversity Areas, Ecological Support Systems, Conservation Targets, Ecological drivers of the ecosystem, Environmental Management Framework, Spatial Development Framework (SDF) and global and international responsibilities.	A number of specialist studies have informed this application and environmental impact assessment and include: • Palaeontology Study • Heritage Study • Terrestrial Biodiversity Study • Aquatic and Wetland Study These studies assisted in identifying any Threatened Ecosystems, Sensitive and vulnerable ecosystems, Critical Biodiversity Areas, Ecological Support Systems, Conservation Targets and Ecological drivers of the ecosystem. Where sensitive species or ecosystem drivers were identified, relevant mitigation measures were put forward to prevent or minimise the impacts.
1.2	How will this project disturb or enhance ecosystems and / or result in the loss or protection of biological diversity? What measures were explored to avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	Minimal and temporary disturbance primarily along pre-determined lines is expected (e.g., compaction, dust, noise). Strict adherence to the Environmental Management Programme (EMPr), including speed limits, restricting operations to daylight hours to reduce impact on nocturnal fauna, confining activities to existing roads/tracks, and avoiding sensitive areas is required. Environmental awareness training for all personnel will include biodiversity protection protocols.
1.3	How will this development pollute and / or degrade the biophysical environment? What measures were explored to either avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	Potential pollution drivers include hydrocarbon spills (from vehicles/trucks), dust, noise, and potential soil erosion in cleared areas. Implementing a strict refuelling protocol within designated bunded areas, regular vehicle maintenance, dust suppression (if necessary), and immediate rehabilitation of access lines post-survey. Noise impacts will be temporary and localised.
1.4	What waste will be generated by this development? What measures were explored to avoid waste, and where waste could not be avoided altogether, what	Waste will be avoided as far as possible. General domestic waste and limited hazardous waste (oily rags, used filters) may be generated on-site during the seismic activity. All waste will be stored in

Ref No.	Question	Answer
	measures were explored to minimise, reuse and / or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?	designated bins, and removed each day or after the seismic activities, and be disposed of by a licenced waste removal company.
1.5	How will this project disturb or enhance landscapes and / or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	A Heritage Impact Assessment (HIA) was conducted. All identified heritage sites (archaeological, cultural, or paleontological) will be marked as no-go areas and avoided by the vibroseis trucks and survey personnel. Should any chance finds occur, the national heritage resources legislation "stop work" procedure will be immediately implemented.
1.6	How will this project use and / or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	The project's purpose is to search for new non-renewable resource pockets (gas/helium) which, if proven viable, would be part of the national energy mix, potentially reducing reliance on other, currently more polluting, non-renewable resources. The seismic itself uses minimal resources.
1.7	How will this project use and / or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and / or impacts on the ecosystem jeopardise the integrity of the resource and / or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts?	Impacts include minor temporary water use for dust suppression and ablutions. The short duration and limited scope (temporary vibroseis lines) will not impact the integrity of the ecosystem. Water will be sourced responsibly and legally, avoiding over-extraction from any single local source
1.7.1	Does the proposed project exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-materialised growth)?	The project aims to identify local energy/resource reserves (gas/helium), which, if developed, could reduce dependence on imported energy, potentially stabilising local energy security and promoting regional economic growth. The exploration phase itself has minimal resource dependence.

Ref No.	Question	Answer
1.7.2	Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used?	The exploration for gas (LNG as a transition fuel, and Helium as a strategic resource) is highly justifiable at a national level to support energy transition and technological needs. The use of the land for a temporary, non-invasive seismic survey is the best use at this stage to determine resource viability before any permanent land commitment is made.
1.7.3	Do the proposed location, type and scale of development promote a reduced dependency on resources?	The project scope (seismic exploration area) is large-scale, although the activity itself is small-scale, and temporary. If successful, it contributes to securing domestic energy/resource supply.
1.8	How were a risk-averse and cautious approach applied in terms of ecological impacts	
1.8.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	In order to prevent repetition, the reader is directed to the assumptions and limitations presented in Section 11.
1.8.2	What is the level of risk associated with the limits of current knowledge?	The level of risk is considered low to medium, primarily due to the temporary nature and small physical footprint of the seismic survey. All known high-risk areas identified by specialists have been excluded.
1.8.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	A 100m buffer will be applied to all watercourses and wetlands (where legally required and/or environmentally advised) and all known sensitive habitats.
1.9	How will the ecological impacts resulting from this development impact on people's environmental right in terms following?	
1.9.1	Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	Negative impacts include temporary noise nuisance for immediately adjacent landowners. Noise will be limited to daylight working hours. All landowners/occupiers along the proposed lines will be consulted and informed of the schedule well in advance. Air quality impacts (dust) will be managed via speed control and, if required, water spraying (dust suppression). The ecological impacts are temporary, localised, and reversible. Therefore, the impact on people's environmental right to an environment that is not harmful to their health or well-being is expected to be negligible in the long term
1.9.2	Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	The positive impact of job creation has been identified and the requirement for local upliftment in the form of employment creation or social programmes put forward.

Ref No.	Question	Answer
1.10	Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	The impact on third party wellbeing, livelihoods and ecosystem services is of a low negative significance as the predominant land use of the affected properties is commercial agriculture, and the site sensitivities from a socio-economic and biophysical point of view have been identified and mitigation measures have been put forward which must be considered prior to the final placement of infrastructure. Furthermore, landowner negotiations prior to seismic study activities will additionally be undertaken to limit any negative impacts on human wellbeing, livelihoods and/or ecosystems.
1.11	Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives / targets / considerations of the area?	The impact is predominantly low due to the temporary and spatially restricted nature of the survey. The development will not compromise ecological integrity objectives, provided that all EMPr measures (especially the avoidance of sensitive habitats) are strictly implemented.
1.12	Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	The following alternatives have been considered: Project Layout Alternatives: 1. Do nothing (No-Go). 2. Seismic line routes over entire Cluster 2 area, with no avoidance mitigations. 3. Alternative seismic line routes, where source lines are identified and chosen that avoids watercourses, steep slopes, and sensitive habitats, reducing ecological impact to the minimum necessary for data acquisition. Undertaking activities outside sensitive breeding seasons also constitutes a key environmental option. Scheduling Alternatives: 1. Undertaking of seismic activity continuously with no scheduling. 2. Undertaking of seismic activity during specific scheduled seasons, to avoid wildlife migration, breeding periods, hunting seasons, and active agricultural cycles (planting and harvesting),
1.13	Describe the positive and negative cumulative ecological / biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	The project is short-term and low-impact. Cumulative effects are minimal unless combined with other concurrent, spatially overlapping, high-impact activities (e.g., intensive mining or large-scale infrastructure development). Provided the rehabilitation is successful, no long-term cumulative negative impact is anticipated.

Ref No.	Question	Answer
2	Promoting justifiable economic and social development	
2.1	What is the socio-economic context of the area, based on, amongst other considerations, the following?	
2.1.1	The Integrated Development Plan, IDP, (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks or policies applicable to the area,	Details of the IDP's for the Lejweleputswa District Municipality (LDM) as well as the Matjhabeng and Masilonyana Local Municipalities are included in Section 8.3. The seismic exploration for helium and methane gas aligns with the strategic objectives of the Lejweleputswa, Matjhabeng, and Masilonyana IDPs by directly addressing the regional need for economic diversification. The IDPs highlight a decline in the traditional gold mining sector, which has led to high unemployment and poverty; this project serves as an intervention to "harness new mining potential" and revitalize the industrial base near Welkom. Specifically, the project supports the Local Economic Development (LED) mandates of these municipalities by introducing a new extractive industry that can provide job opportunities for the region's large youth population. Spatially, it reinforces Welkom's role as a "Very High" potential economic node, utilizing existing infrastructure to foster growth. By exploring for gas, the project also moves the region toward the IDP goals of energy security and a "green economy" transition, helping to transform the Free State into a diversified energy hub.
2.1.2	Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.),	
2.1.3	Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and	
2.1.4	Municipal Economic Development Strategy ("LED Strategy").	
2.2	Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?	Although the seismic survey will not have a significant contribution to the socio-economic impacts, it may result in future positive socio-economic impacts in the local, regional and national economy. Refer to the impact assessment in Section 9.1 in this report.
2.2.1	Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	Yes, by prioritising the hiring of local unskilled and semi-skilled labour as far as possible and providing on-the-job skills transfer (e.g., safety protocols, driving of specialised equipment).
2.3	How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	Tetra4 is currently in the process of providing certain basic services such as water and electricity to the Adamsons Vley community as part of the Social and Labour Plan commitments for their existing production project. This is an ongoing process throughout the project implementation and would be extended to other communities in due course and where possible. Focus group consultation with the Adamsons Vley community, the community members acknowledged that the water and solar electricity project was currently

Ref No.	Question	Answer
		underway in their community. They have been provided with a new borehole, pump and storage tanks for water. In addition, solar PV for lighting is being installed on the houses. Should the Production right area extend and result in viable exploration boreholes put into production, there would be further opportunities for SLP upliftment in the long term.
2.4	Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term? Will the impact be socially and economically sustainable in the short- and long-term?	None of the identified impacts are anticipated to have a high negative impact significance post mitigation. It is therefore not anticipated that this project will result in negative equitable impact distribution in the short- and long-term. If the resource is viable, the eventual production phase would provide substantial, equitable, and sustainable economic benefits (tax revenue, permanent jobs, energy security) for future generations, thereby outweighing the minimal temporary impact of the seismic phase.
2.5	In terms of location, describe how the placement of the proposed development will:	
2.5.1	Result in the creation of residential and employment opportunities in close proximity to or integrated with each other.	The seismic study project will promote further employment opportunities (to a limited extent) both locally and regionally. This project is not anticipated to have a material impact on the need for transport of people and goods or impact on access to public transport.
2.5.2	Reduce the need for transport of people and goods.	
2.5.3	Result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms of public transport),	
2.5.4	Compliment other uses in the area,	The seismic study will compliment the current exploration activities, introducing non-invasive exploration so as to minimise disruption for landowners and impacts on agricultural resources and ecosystems, whilst provide a large-scale model of the gas resources in the Production Right Area.
2.5.5	Be in line with the planning for the area.	Details of the IDP's for the Lejweleputswa District Municipality (LDM) as well as the Matjhabeng and Masilonyana Local Municipalities are included in Section 8.3. The seismic exploration for helium and methane gas aligns with the strategic objectives of the Lejweleputswa, Matjhabeng, and Masilonyana IDPs by directly addressing the regional need for economic diversification. The IDPs highlight a decline in the traditional gold mining sector, which has led to high unemployment and poverty; this project serves as an intervention to "harness new

Ref No.	Question	Answer
		mining potential" and revitalize the industrial base near Welkom. Specifically, the project supports the Local Economic Development (LED) mandates of these municipalities by introducing a new extractive industry that can provide job opportunities for the region's large youth population. Spatially, it reinforces Welkom's role as a "Very High" potential economic node, utilizing existing infrastructure to foster growth. By exploring for gas, the project also moves the region toward the IDP goals of energy security and a "green economy" transition, helping to transform the Free State into a diversified energy hub.
2.5.6	For urban related development, make use of underutilised land available with the urban edge.	Not applicable. The proposed project is not located in an urban area.
2.5.7	Optimise the use of existing resources and infrastructure,	Given the mobile and temporary nature of the activity, the use of existing resources and infrastructures will be limited, predominantly by utilising existing access roads as far as possible for vehicles other than the vibroseis truck to access the site. Additionally, the activity does not require bulk infrastructure expansions.
2.5.8	Opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),	
2.5.9	Discourage "urban sprawl" and contribute to compaction / densification.	This project is located in a rural setting and is not anticipated to have an impact on or any control over urban sprawl in the nearby towns.
2.5.10	Contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs,	Not applicable for the seismic phase, but potential future development could be planned to enhance existing infrastructure and create integrated human settlements.
2.5.11	Encourage environmentally sustainable land development practices and processes,	The project is governed by the principles of NEMA, promoting environmental sustainability and requiring immediate rehabilitation.
2.5.12	Take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),	The location is determined by the geological presence of the target resource (gas/helium), which is the primary locational factor.
2.5.13	The investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential).	The investment is high-risk/high-reward exploration capital. If successful, the area will become an area of high economic potential, justifying the initial investment.
2.5.14	Impact on the sense of history, sense of place and heritage of the area and the socio-	Impacts are managed through the HIA and a "no-go" buffer on all identified sites, thereby preserving

Ref No.	Question	Answer
	cultural and cultural-historic characteristics and sensitivities of the area, and	the sense of history and place. The temporary nature of the activity prevents long-term alteration of the landscape.
2.5.15	In terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	Not directly, but the consultation process fosters greater integration between the community, landowners, and the project proponent.
2.6	How was a risk-averse and cautious approach applied in terms of socio-economic impacts	
2.6.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Refer to section 11 of this report.
2.6.2	What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	The level of risk is considered low as the project is not expected to have far reaching negative impacts on socio-economic conditions.
2.6.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	Specific emphasis was placed on the potential socio-economic impacts. Engagements with affected communities and landowners were undertaken to understand the dynamic socio-economic environment and the risks associated with the project. Valuable feedback was received and thereafter specific conditions of the authorisation have been put forward to ensure that pre-emptive attention is given to these impacts at all times. In essence, no development is to take place on a particular property until such time as the landowner has been thoroughly consulted, signed contracts in place and suitable compensation made for any adverse impacts on livelihoods.
2.7	How will the socio-economic impacts be resulting from this development, impact on people's environmental right in terms following:	
2.7.1	Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	Refer to the impact assessment in Section 9.3.11 of this report. Both positive and negative socio-economic impacts have been identified and relevant mitigation measures put forward to reduce negative impacts and enhance positive impacts as far as practicable.
2.7.2	Positive impacts. What measures were taken to enhance positive impacts?	
2.8	Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socioeconomic impacts will result in	

Ref No.	Question	Answer
	ecological impacts (e.g. over utilisation of natural resources, etc.)?	
2.9	What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	
2.10	What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	
2.11	What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	The potential impact on existing land uses has been identified from the start of this application process and an assessment of this impact as well as mitigation measures put forward to prevent undue negative impacts in this regard. Refer to the impact assessment in Sections 9.1 and 9.3 of this report.
2.12	What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?	Refer to the impact assessment in Section 9.12 of this report. The BA and EMPr specify timeframes within which mitigation measures must be implemented.
2.13	What measures were taken to:	
2.13.1	Ensure the participation of all interested and affected parties.	Notwithstanding the detailed description of the stakeholder consultation process included in Section 7 of this report, the consultation process has been undertaken in 3 languages (English, Afrikaans and Sesotho), published in newspaper advertisements, erection of 30 site notices (in all three languages), direct emails, faxes, SMSs and registered letters where contact information was available. Furthermore, public meetings will be undertaken during the BA phase.
2.13.2	Provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,	
2.13.3	Ensure participation by vulnerable and disadvantaged persons,	
2.13.4	Promote community wellbeing and empowerment through environmental education, the raising of environmental	

Ref No.	Question	Answer
	awareness, the sharing of knowledge and experience and other appropriate means,	
2.13.5	Ensure openness and transparency, and access to information in terms of the process,	
2.13.6	Ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge,	
2.13.7	Ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein will be promoted?	
2.14	Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	
2.15	What measures have been taken to ensure that current and / or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	Workers will be educated on a regular basis as to the environmental and safety risks that may occur within their work environment. Furthermore, adequate measures will be undertaken to ensure that the appropriate personal protective equipment is issued to workers based on the areas that they work and the requirements of their job. Their right to refuse work (if considered dangerous) will be included in the education programme.
2.16	Describe how the development will impact on job creation in terms of, amongst other aspects:	
2.16.1	The number of temporary versus permanent jobs that will be created.	The seismic survey project does not directly facilitate job-opportunities, however the non-invasive exploration activities will be an opportunity for temporary and to a lesser degree, permanent jobs. Should an exploration area be deemed viable and put into the next phase (drilling of an exploration or production well), it will contribute to the provide further employment opportunities. The exact number of workers to be appointed is not determined at this stage, however once exploration activities commence the number will be included in the relevant applications.
2.16.2	Whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area).	
2.16.3	The distance from where labourers will have to travel.	
2.16.4	The location of jobs opportunities versus the location of impacts.	

Ref No.	Question	Answer
2.16.5	The opportunity costs in terms of job creation.	
2.17	What measures were taken to ensure:	
2.17.1	That there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment.	The BA Process requires governmental departments to communicate regarding any application. In addition, all relevant departments are notified at various phases of the project by the EAP and any feedback received from government departments is considered where relevant.
2.17.2	That actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures.	
2.18	What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	Environmental attributes that may be impact by this project have been identified and where relevant, specialist input has been solicited to ensure that a rigorous impact assessment process is undertaken. Where positive impacts on the interests of the public have been identified (e.g. job creation, impact on existing land use, etc.), mitigation measures are put forward to enhance positive impacts and/or reduce negative impacts.
2.19	Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	The mitigation measures are standard and realistic for a seismic survey (rehabilitation, waste management, noise control). The long-term environmental legacy is anticipated to be neutral (zero environmental impact) due to the temporary nature and rehabilitation requirement.
2.20	What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	Financial provision (as required by NEMA) will be provided to cover the costs of rehabilitation and remediation in the event of environmental damage, ensuring the polluter pays principle is upheld. Tetra4 provides annual updates of their Production Right financial provisioning to the Competent Authority and the provision will be adjusted to reflect the additional activities associated with the PR extension costs.
2.21	Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	Refer to Section 6 which contains a description of the process followed to reach the proposed preferred site.
2.22	Describe the positive and negative cumulative socio-economic impacts bearing	Refer to the impact assessment and mitigation measures in Section 9.2.1 of this Report.

Ref No.	Question	Answer
	in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?	

6 PROJECT ALTERNATIVES

In terms of the EIA Regulations published in Government Notice (GN) R982 of 2014, as amended, feasible and reasonable alternatives must be identified and considered within the environmental assessment process. An alternative is defined as:

"…in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to the:

(a) property on which or location where it is proposed to undertake the activity;

(b) type of activity to be undertaken;

(c) design or layout of the activity;

(d) technology to be used in the activity;

(e) operational aspects of the activity; and

(f) Includes the option of not implementing the activity."

In terms of Section 24 of NEMA, the proponent is required to demonstrate that alternatives have been described and investigated in sufficient detail during the EIA process All reasonable and feasible alternatives must be identified and screened to determine the most suitable alternatives to consider and assess in the EIA phase. There are, however, some significant constraints that have to be considered when identifying alternatives for a project with this scope. Such constraints include social, financial and environmental issues, which are discussed as part of the evaluation of the alternatives for this project. In order to ensure full disclosure of alternative activities, it is important that various role players contribute to their identification and evaluation. Stakeholders have an important contribution to make during the EIA Process and each role is detailed as follows:

- The role of the environmental assessment practitioner is to:
    - encourage the proponent to consider all feasible alternatives;
    - identify reasonable alternatives;
    - provide opportunities for stakeholder input to the identification and evaluation of alternatives;
    - document the process of identification and selection of alternatives;
    - provide a comprehensive consideration of the impacts of each of the alternatives; and
    - document the process of evaluation of alternatives.
- The role of the proponent is to:
    - assist in the identification of alternatives, particularly where these may be of a technical nature;
    - disclose all information relevant to the identification and evaluation of alternatives;
    - be open to the consideration of all reasonable alternatives; and
    - be prepared for possible modifications to the project proposal before settling on a preferred option.
- The role of the public is to:
    - assist in the identification of alternatives, particularly where local knowledge is required;
    - be open to the consideration of all reasonable alternatives; and

- recognise that there is rarely one favoured alternative that suits all stakeholders and that alternatives will be evaluated across a broad range of criteria, including environmental, social and economic aspects.

For any alternative to be considered feasible such an alternative must meet the need and purpose of the development proposal without presenting significantly high associated impacts. As mentioned in Section 5 of this Report, the need for the proposed project includes the following key drivers:

- The project aims to find local energy reserves that can reduce the country's dependence on imported energy, which would help stabilize local energy security and secure a domestic supply chain.
- LNG is specifically identified as a "transition fuel." Adding viable local gas to the national energy mix is intended to reduce the country's reliance on other, more polluting non-renewable resources.
- Helium is highlighted as a "strategic resource" that is justifiable at a national level to support ongoing technological needs.
- While the seismic exploration itself is temporary and has a small physical footprint, proving the viability of these resources is the necessary first step toward a production phase. That future phase is the ultimate economic driver, holding the potential for regional economic growth, sustainable tax revenue, and permanent job creation

Essentially, alternatives represent different means of meeting the general purpose and need of the proposed project through the identification of the most appropriate and feasible methods of development/ production, all of which are discussed below. Alternatives can further be distinguished into discrete or incremental alternatives. Discrete alternatives are overall development options, which are typically identified during the pre-feasibility, feasibility and or scoping phases of the EIA process (DEAT, 2004). Incremental alternatives typically arise during the EIA process and are usually suggested as a means of addressing identified impacts. These alternatives are closely linked to the identification of mitigation and management measures and are not specifically identified as distinct alternatives. Incremental alternatives to be considered by the applicant include the type of irrigation system to be used and the method of sourcing power to the pivot to turn around its centre.

The only discrete alternatives considered, as described in the sections that follow, was the Preferred Alternative and the No-Go Alternative, as no other feasible alternatives could be identified with regards to location, process, technology or the type of activity owing to the nature of the proposed seismic survey.

6.1 LOCATION ALTERNATIVES

Location alternatives can apply to the entire Project (e.g. the strategic decision to locate the proposed development at a specific geographical location), as well as more specific footprints of individual components of the project.

No feasible location alternatives exist for the proposed seismic survey, as the activity is fundamentally dictated by the spatial extent of the granted Exploration Right and the specific subsurface geological targets identified during preliminary desktop studies. Seismic exploration is a site-specific activity intended to verify the presence and extent of hydrocarbon resources in a particular subterranean area; therefore, moving the survey to a different geographic location would fail to meet the project's primary objective. Furthermore, the survey area is legally constrained by the boundaries of the Exploration Right. While the broad location is fixed, the project will instead focus on 'Layout and Design Alternatives'—such as the optimisation of seismic lines and access tracks—to ensure that the specific path of the seismic truck avoids sensitive environmental receptors and existing infrastructure within the designated area.

The proposed survey lines (green lines) can be seen in Figure 5 and are the pathways that the truck will travel.

6.2 SCHEDULING ALTERNATIVES

Scheduling alternatives are sometimes known as sequencing or phasing alternatives. In this case an activity may comprise a number of components, which can be scheduled in a different order or at different times and as such produce different impacts.

Due to the extensive footprint of the proposed project area, the seismic surveys will be executed using a phased approach. The timing of these activities is critical, as survey operations have the potential to disrupt local ecological systems and socio-economic activities, including wildlife migration, breeding periods, hunting seasons, and active agricultural cycles (planting and harvesting).

To mitigate these impacts, the primary scheduling alternative involves timing the survey activities to avoid these sensitive windows. Under this alternative, seismic surveys will be strictly scheduled to certain agricultural periods, such as fallow seasons, or restricted to specific timeframes mutually agreed upon with the affected landowners.

6.3 PROCESS ALTERNATIVES

Process alternatives imply the investigation of alternative processes or methods to achieve the same goal for the proposed Project. This includes using environmentally friendly designs or materials and re-using scarce resources like water and non-renewable energy sources. Process alternatives will be defined and implemented as incremental alternatives during the assessment and incorporated into the EMPr.

6.4 TECHNOLOGY ALTERNATIVES

The selection of the technology alternatives or techniques to be adopted for the operation of the Project are described in this section. The proposed seismic survey method utilizes specialized heavy vehicles (vibroseis trucks) equipped with heavy baseplates that vibrate at controlled frequencies to generate acoustic signals. Given the relatively flat and accessible agricultural terrain in the Free State, using vibroseis trucks are highly viable. It is generally preferred from an environmental perspective as it operates on the surface, eliminating the need for drilling, reducing the risk of groundwater interaction, and allowing for immediate cessation of the source if a sensitive receptor is identified.

6.5 ACTIVITY ALTERNATIVES

Activity alternatives refer to project alternatives which requires a change in the nature of the proposed activity. The seismic survey involves the active acquisition of subsurface geological data using acoustic energy sources. While this activity temporarily introduces noise, vibration, and vehicle movement into the environment, it provides the high-resolution data necessary to accurately map subsurface formations. This activity is preferred over other exploration activities such as drilling, as it is less invasive and has lower impacts on the receiving environment.

6.6 NO-GO ALTERNATIVE

The no-go alternative option means ‘do nothing’ or the option of not undertaking the proposed preferred activities, consequently leading to the continuation of the current land-use, which is leaving the location as a vegetated area. As such, the ‘do nothing’ alternative or keeping the current status quo of a with no activities occurring on-site also provides the baseline against which the impacts of other alternatives should be compared.

Under the No-Go alternative, the proposed site would experience no immediate impacts on agricultural operations, local ecology, or seasonal hunting activities. However, the opportunity to acquire high-resolution geological data would be lost, potentially impeding future regional economic and resource development. Furthermore, without the macro-level geological model provided by a seismic survey, the applicant would need to revert to exploration drilling to locate and identify potential gas reserves. This untargeted approach would ultimately result in a larger cumulative environmental footprint, greater unnecessary disturbance to landowners, and an inefficient use of both time and resources.

6.7 PROJECT LAYOUT

The seismic survey involves adhering strictly to a predefined, mathematically straight grid of survey lines to optimise data collection geometry (see Figure 5). Following this rigid grid is highly likely to intersect with sensitive receptors such as wetlands, active crop fields, farm infrastructure, heritage sites or critical ecological habitats. Mitigations have therefore been put forth to avoid impacts on these sensitive areas. This process alternative prioritizes environmental and social sensitivities over strict geometric adherence. The seismic lines and vehicle paths will be micro-sited and deviated to circumvent identified "no-go" areas. This includes routing the survey to utilize existing farm roads and firebreaks wherever possible, bending lines around natural pans or drainage lines, and adjusting the layout to avoid fields during active planting or harvesting, if the survey cannot be undertaken during a different season (see Section 6.2), ensuring the physical footprint is minimized.

6.8 PREFERRED ALTERNATIVE

The preferred alternative for this project represents an integrated approach designed to successfully acquire essential subsurface data while strictly minimizing the spatial and temporal footprint on the receiving environment. Unlike standard infrastructure developments, there are no feasible macro-site alternatives for this project. The location of the proposed seismic survey is fundamentally fixed, dictated by the specific underlying geological formations targeted for gas reserves. Furthermore, the operational footprint is strictly bound by the legal boundaries of the applicant's existing production and exploration rights.

While the broader site is fixed, the preferred process alternative employs a highly flexible approach to the internal survey layout. Rather than adhering to a rigid, mathematically straight grid, all planned seismic lines and vehicle access paths will be actively deviated and micro-sited. This ensures that operations completely avoid all identified biophysical and socio-economic "no-go" areas, safeguarding sensitive ecological receptors, wetlands, and critical farming infrastructure.

To mitigate impacts on the dynamic activities within the Free State landscape, the preferred scheduling alternative dictates that all survey operations are strategically timed. The activity will be scheduled to avoid peak agricultural seasons—specifically planting and harvesting—to ensure that the local agricultural economy and daily farming operations are not disrupted.

Finally, the undertaking of a terrestrial seismic survey is the preferred activity because it is significantly less invasive to the receiving environment than traditional physical exploration methods. It allows the applicant to generate a comprehensive, large-scale geological model using temporary, surface-level technology. This avoids the extensive surface disturbance, vegetation clearing, earthworks, and potential groundwater interception inherently associated with exploration drilling. By utilizing this non-invasive method first, any future drilling can be strategically targeted, thereby averting unnecessary environmental degradation and optimizing the expenditure of affected landowners’ time and resources.

7 STAKEHOLDER ENGAGEMENT

South Africa, being one of the countries with the most progressive constitutions, enshrined the public's right to be involved in decisions that may affect them in its Constitution. Section 57(1) of the new Constitution that provides: "*The National Assembly may (b) make rules and orders concerning its business, with due regard to representative and participatory democracy, accountability, transparency and public involvement".* This provision, along with several others gave rise to many new trends in South African legislation. In environmental legislation, the idea of public participation (or stakeholder engagement) features strongly and especially the National Environmental Management Act (Act 107 of 1998, NEMA) and the recent regulations passed under the auspices of this Act makes very strict provisions for public participation in environmental decision-making.

Public participation can be defined as..."*a process leading to a joint effort by stakeholders, technical specialists, the authorities and the proponent who work together to produce better decisions than if they had acted independently*". From this definition, it can be seen that the input of the public is regarded as very important indeed.

The Public Participation Process (PPP) is designed to provide sufficient and accessible information to Interested and Affected Parties (I&APs) in an objective manner to assist them to:

During the Environmental Authorisation:

- Verify that their issues have been recorded;
- Comment on the findings of the environmental assessments; and
- Provide relevant local information and knowledge to the environmental assessment.

The PPP is a requirement of several pieces of South African Legislation and aims to ensure that all relevant I&APs are consulted, involved and their opinions are taken into account and a record included in the reports submitted to Authorities. The process ensures that all stakeholders are provided this opportunity as part of a transparent process which allows for a robust and comprehensive environmental study. The PPP for the necessary authorisation required for the project needs to be managed sensitively and according to best practises in order to ensure and promote:

- Compliance with international best practice options;
- Compliance with national legislation;
- Establishment and management of relationships with key stakeholder groups; and
- Encouragement of involvement and participation in the environmental study and authorisation/approval process.

As such, the purpose of the PPP and stakeholder engagement process is to:

- Introduce the proposed project and process for the authorisation project;
- Explain the environmental authorisation;
- Determine and record issues, concerns, suggestions, and objections to the project;
- Provide opportunity for input and gathering of local knowledge;
- Establish and formalise lines of communication between the I&APs and the project team;
- Identify all significant issues for the project; and
- Identify possible mitigation measures or environmental management plans to minimise and/or prevent negative environmental impacts and maximise and/or promote positive environmental impacts associated with the project.

This Public Participation Report (PPR) lists all verbal and written issues raised by I&APs during the call to register period from the 18th of November to date. A breakdown of the PPP is given within the remaining sections of this PPR.

7.1 LEGAL COMPLIANCE

The PPP must comply with all environmental legislation that requires public participation as part of an application for authorisation or approval; namely, the National Environmental Management Act (NEMA, Act No. 107 of 1998).

Adherence to the requirements of the above-mentioned Act will allow for an Integrated PPP to be conducted, and in so doing, satisfy the requirements for public participation referenced in the Act. The details of the Integrated PPP are provided below.

7.2 IDENTIFICATION OF INTERESTED AND AFFECTED PARTIES (I&APS)

An initial I&AP database has been compiled from historic projects in the area, and Windeed searches were conducted to obtain the contact details of the surrounding landowners. The I&APs referred to in the PPR include:

- Pre-identified and registered landowners and surrounding landowners;
- Pre-identified and registered key stakeholders;
- Regulatory authorities;
- Specialist interest groups; and
- All I&APs who responded to the initial notifications and requested to be registered.

Efforts to pre-identify key I&APs involved various avenues such as consultation with the proponent and known landowners within the study area, review of related previously conducted studies, and identification of key interest groups and authorities within the vicinity of the study area and municipality. Refer to Appendix D for the Key Stakeholder/I&AP Database.

7.2.1 LIST OF ORGANS OF STATE IDENTIFIED AND NOTIFIED

The following key I&APs, but not limited to, were notified of the proposed project and invited to participate in the public participation process:

- Eskom Soc Ltd
- Free State Department of Agriculture and Rural Development
- Free State Department of Cooperative Governance and Traditional Affairs
- Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs
- Free State Department of Mineral Resources and Energy
- Free State Department of Police, Roads and Transport
- Free State Department of Public Works and Infrastructure
- Free State Department of Water and Sanitation
- Free State Development Corporation
- Free State Heritage Resources Authority
- Free State Provincial Shared Services Centre (PSSC)
- Lejweleputswa Development Agency
- Lejweleputswa District Municipality
- Masilonyana Local Municipality
- Matjhabeng Local Municipality
- National Department of Agriculture, Land Reform, and Rural Development (DALRRD)

- National Department Of Forestry, Fisheries and Environment (DFFE)
- National Department of Land Reform and Rural Development (DALRRD)
- National Department of Mineral Resources and Energy (DMRE)
- National Department of Transport
- National Department of Water and Sanitation (DWS)
- National Energy Regulator of South Africa (NERSA)
- National House of Traditional Leaders
- Petroleum Agency of South Africa (PASA)
- Presidential Climate Change Commission
- Sedibeng Water
- South African Civil Aviation Authority (SACAA)
- South African Heritage Resources Agency (SAHRA)
- South African National Biodiversity Institute (SANBI)
- South African National Roads Agency Soc Ltd (SANRAL)
- Stilte Primary School
- Transnet Soc Ltd
- Ward Councillors

7.2.2 LIST OF OTHER KEY I&APS IDENTIFIED AND NOTIFIED

- Pre-identified and registered landowners and surrounding landowners.
- African Carbon Energy (Pty) Ltd
- African Conservation Trust
- Afriforum
- Agri Free State
- Agri South Africa
- Birdlife South Africa
- Botanical Society
- Centre for Environmental Rights (CER)
- Conservation South Africa (CSA)
- Council for Geoscience
- Council of Scientific & Industrial Research (CSIR)
- Earth Life Africa
- Endangered Wildlife Trust (EWT)
- Federation for a Sustainable Environment (FSE)
- Frack Free South Africa
- Free State Agriculture
- Free State Department of Water and Sanitation
- Free State Wetland Forum
- Green Connection
- GroundWork South Africa
- GUBICO
- Mining Affected Communities United in Action (MACUA)
- Mining and Environmental Justice Community Network of South Africa (MEJCONSA)
- National Farmers Union
- Natural Justice
- Pele Green Energy
- Sibanye Stillwater
- SOLA Group
- Subsolar Energy
- Tara Wildlife South Africa
- Vaal Environmental Justice Alliance (VEJA)
- Wild Trust
- Wildlife and Environment Society of South Africa (WESSA)

- World Wildlife Fund (WWF)

7.3 NOTIFICATION OF INTERESTED AND AFFECTED PARTIES

This section provides details on the notifications that were distributed as part of the consultation process to date.

7.3.1 INITIAL NOTIFICATION OF KEY I&APS

The PPP commenced on the 20th of November 2025 with an initial call to register notification. Notification during this initial consultation was given in the manner described below.

7.3.2 EMAILS, REGISTERED MAIL AND FAXES

Notification letters (in English, Sesotho, and Afrikaans) were distributed to pre-identified I&APS through either faxes, SMSs, registered mail, and/or emails on the 20th of November 2025.

The notification documents included the following information:

- Authorisations required;
- Sufficient detail of the proposed development to enable I&APs to assess/surmise what impact the development will have on them or the use of their land;
- The purpose of the proposed project;
- Details of the application processes associated with proposed activities;
- Details of the affected properties;
- Details of the South African environmental legislation that must be adhered to;
- Contact details of the EAP.

Please refer to Appendix D for initial notification and proofs.

7.3.2.1 **NEWSPAPER AND GAZETTE ADVERTISEMENTS**

Advertisements (in English, Sesotho, and Afrikaans) describing the proposed project and Environmental Impact Assessment process were placed in the vista Newspaper with circulation in the vicinity of the study area on the 27h of November 2025. The Gazette Notice was placed in the National Government Gazette on the 12th of December 2025. The newspaper and Gazette Notice adverts included the following information:

- Project name;
- Applicant name;
- Project location;
- Nature of the activity;
- Legislative requirements; and
- Relevant EIMS contact person for the project.

Please refer to Appendix D for proof of the advert and gazette notice placed.

7.3.2.2 **SITE NOTICE PLACEMENT**

Thirty (30) A1 correx board site notices (in English, Sesotho, and Afrikaans) were placed at thirty (30) locations around the proposed project study area on the 18th of November 2025. The on-site notices included the following information:

- Project name;
- Applicant name;
- Project location;
- Map of proposed project area;
- Project description;
- Legislative requirements; and
- Relevant EIMS contact person for the project.

Please refer to Appendix D for proof of site notice and site notice distribution.

7.3.3 NOTIFICATION OF INTERESTED AND AFFECTED PARTIES OF BASIC ASSESSMENT REPORT AVAILABILITY

Notification (in English, Sesotho, and Afrikaans) regarding the availability of the Basic Assessment Report for public review and comment will be provided to pre-identified and registered I&APs. The notifications will be distributed through either email, registered mail, fax, and/or SMS, where contact details are available.

Contact details will be provided to I&APs should they require assistance accessing the information or require copies of the reports.

A hard copy of the Basic Assessment Report will be placed at the Virginia Public Library for a period of 30 days.

7.4 SUMMARY OF PUBLIC PARTICIPATION OPPORTUNITIES

The table below provides a summary of the opportunities provided to I&APs for participation in the public participation process to date.

Table 14: Summary of Public Participation Opportunities

Action	Description	Publication/Place	Date
Initial Call to Register	Notification of landowners, occupiers, and other key I&APs.	Affected landowners and key I&APs were notified via email, fax, SMSs and/or post.	20 November 2025
	Placement of site notices.	Thirty (30) A1 correx board site notices (in English, Sesotho, and Afrikaans) were placed at six (6) locations along the proposed project study area.	17 November 2025
	Newspaper advertisement and Gazette Notice.	Advertisements (in English, Sesotho, and Afrikaans) describing the proposed project and BA process were placed in the Vista Newspaper.	27 November 2025
		The Gazette Notice was placed in the National Government Gazette.	12 December 2025

Action	Description	Publication/Place	Date
Availability of Basic Assessment Report for public review	Placement of hard copy Basic Assessment Report.	One (1) hard copy of the report will be submitted to the Virginia Public Library where members of the public can access the report.	TBA
	Placement of Basic Assessment Report electronic copy.	An electronic copy of the report will be placed on the EIMS website.	TBA-

7.5 RECORD OF ISSUES RAISED

Comments on the proposed project were solicited from pre-identified and registered I&APs and key stakeholders. To date, the following comments have been received:

- I&AP Registrations.
- Transnet Pipelines approved the wayleave application and had no objections to the proposed project.
- An I&AP offered farmer contact information for access into some properties.
- Request for project map files.
- A request from harmony gold mining for the applicant to consult with them before any activity due to overlapping mining rights.
- SACAA had no comments, however, advised that should there be structures that are of/exceed a certain height, the relevant application process must be followed.

All comments and/or queries received to date are included in Appendix D.

8 ENVIRONMENTAL ATTRIBUTES AND BASELINE ENVIRONMENT

This section of the BA Report provides a description of the environment that may be affected by the proposed project. Aspects of the physical, biological, social, cultural heritage and economic environment that could be directly or indirectly affected by, or could affect, the proposed development have been described. This information has been sourced from existing information available for the area and where relevant specialist assessments.

8.1 PHYSICAL ENVIRONMENT

This section describes the physical environmental characteristics of the project area that may be directly or indirectly affected by the proposed seismic survey. The discussion provides a baseline overview of key physical components, including climate, geology, soils, topography, and hydrological features. This information is derived from available desktop data and specialist studies and serves to contextualise the receiving environment, support the identification of environmental sensitivities, and inform the subsequent assessment of potential impacts associated with the proposed activity

8.1.1 CLIMATE

The study area's rainfall is strongly seasonal, and the weather pattern reflects a typical summer rainfall region, with > 80 % of precipitation occurring as convective thunderstorms from October to March. Patched rainfall and evaporation data were sourced from the WR2012 database (Rainfall zone 4C4) and span a period of some 90 years (1920 – 2009). The calculated mean annual precipitation (MAP) for this rainfall zone is 521 mm/a, with the 5th percentile of the data set (roughly equivalent to a 1:20 year drought period) calculated at 343.38 mm/a while the 95th percentile (representing a 1:20 flood period) is calculated at 752.43 mm/a. The highest MAP for the 90 years of rainfall data was recorded as 860.3 mm (1942) while the lowest MAP of 264 mm was recorded during 2006.

Both catchment areas are categorised under evaporation zone 19C which have a mean annual evaporation (s-pan) ranging between 1600 mm/a to 1680 mm/a. The highest evaporation is usually experienced in December (215 mm) while the lowest evaporation is in June (61 mm). The peak rainfall months are December and January, and the annual evaporation volumes are more than threefold the annual precipitation.

8.1.2 GEOLOGY AND PALAEONTOLGY

The following sections summarises the regional and local geology.

8.1.2.1 **REGIONAL GEOLOGY**

Although the project area's surficial geology comprises mostly aeolian sands, quaternary deposits and isolated outcrops of the Karoo Supergroup i.e., dolerite and sandstone/ shales, the greater study area is generally also underlain by rocks of the Witwatersrand Supergroup as well as the Ventersdorp Supergroup. The primary source of gas originates from the Witwatersrand Supergroup as well as the shallower Karoo sediments (Lea, 2017). Figure 9 represents a regional geological cross section (Shango, 2016). It can be inferred from exploration borehole geological logs that the estimated depth of the unconsolidated material on-site is approximately 11.0m (Lea, 2017).

The Witwatersrand Supergroup is a sedimentary deposition across the stable granite-gneiss basement which commenced around 3 billion years ago. In stratigraphic terms the Witwatersrand sequence is divided into two divisions, the lower dominantly marine, slate rich West Rand Group and the upper dominantly alluvial sandstone rich Central Rand Group (Johnson, 2006). The Witwatersrand Supergroup depth within the study area was inferred from exploration borehole geological logs and is estimated at an average depth of >1600.0mbgl (Lea, 2017).

The Ventersdorp Supergroup uncomfortably overlies the Witwatersrand Supergroup. This Group is very thick, more than 4500.0m. The lower Klipriviervberg Group is mafic lava and tuff while the upper Platberg Group is conglomerates and breccia on top of Klipriviervberg, with intermediate and felsic lava higher, with quartzite, shale and siltstone layers in between (Johnson, 2006). The Ventersdorp Supergroup depth within the study area was

inferred from exploration borehole geological logs and is estimated at an average depth of >1120.0mbgl. Gas will be extracted from deep-seated fracture zones associated with the Ventersdorp lavas and Witwatersrand quartzites (Lea, 2017).

The Karoo Super Group is the largest stratigraphic unit in Southern Africa covering almost two thirds of the land surface. The supergroup consists of a sequence of units, mostly of nonmarine origin, deposited between the Late Carboniferous and Early Jurassic, a period of about 120 million years. The Karoo Supergroup consist of argillaceous rocks of the Beaufort Group i.e. lower Adelaide Subgroup (Late Permian) and an upper Tarkastad Subgroup, the Permian Ecca Group which consist largely of shales and sandstones as well as the Dwyka Group (Late Carboniferous to Early Permian) which consists mainly of diamictite (tillite). The Ecca Group underlies the Beaufort Group in all known outcrops and exposures and follows conformably after the Dwyka Group in certain sections, however in some localities overlies unconformably over older basement rocks (Schlüter and Thomas, 2008). The Karoo Supergroup (which include the Beaufort as well as Ecca Groups) depth within the study area was inferred from exploration borehole geological logs and is estimated at an average depth of 300.0mbgl. Refer to Table 15 for a summary of the regional stratigraphical sequence.

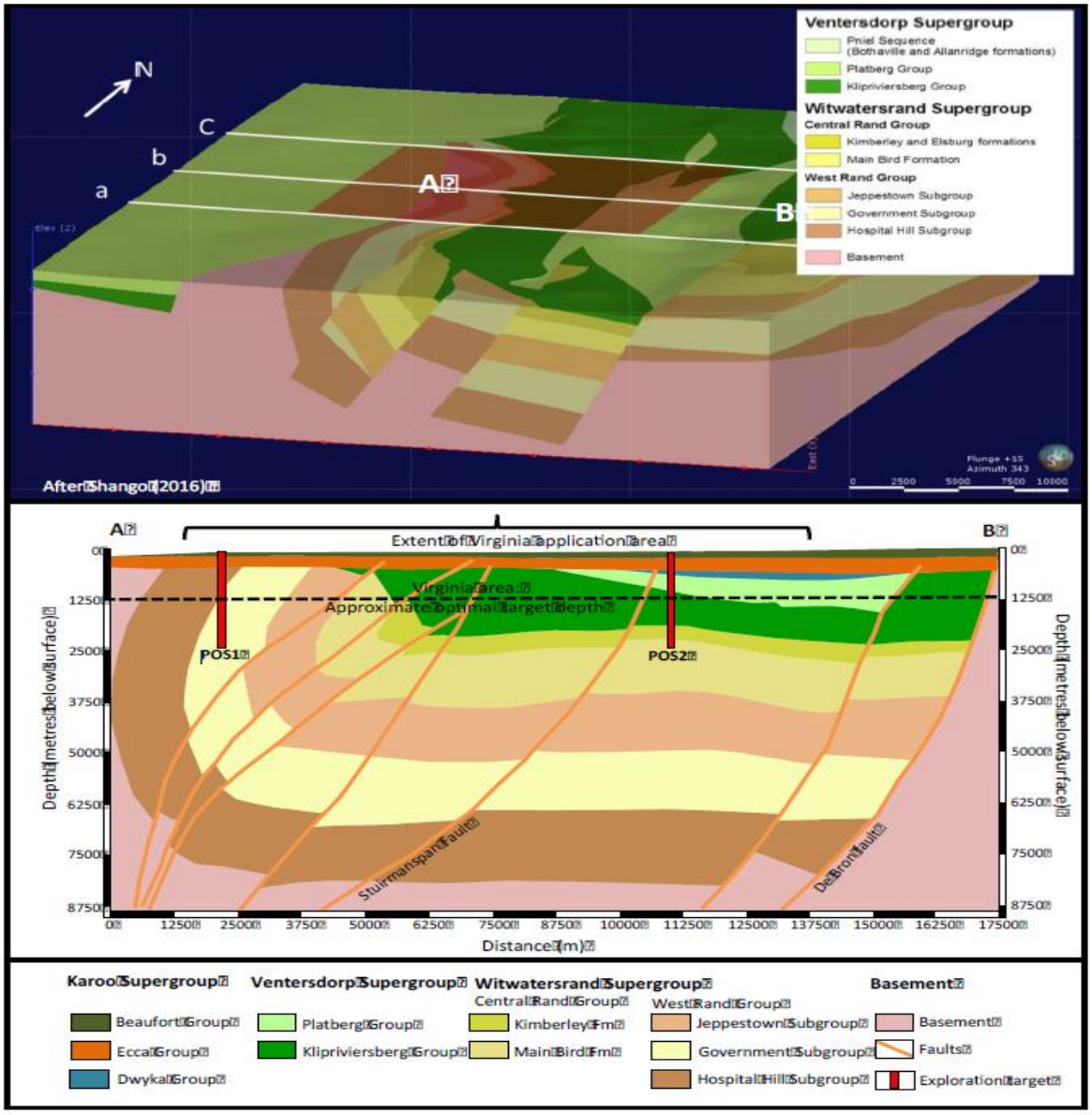


Figure 9: Cross section of the regional geology (after Shango, 2016).

Table 15: Regional stratigraphical sequence.

Lithology	Average depth (m)	Description
Aeolian sand and alluvium	8	Quaternary unconsolidated surficial calcrete, pebbles, gravel, sand and clay
Karoo Supergroup - Ecca and Beaufort Group shales and sandstones	301	Blue-grey mudstone and shale interbedded with very fine to coarse-grained sandstone. Subordinate conglomerate may be present
Dolerite (Sill)	335	Karoo-age dolerite sills and dykes
Karoo Supergroup – Ecca and Dwyka Tillite in places	437	Glaciated bedrock including tillite, diamictite, sandstone, mudstone and conglomerates.
Ventersdorp Supergroup Lava	805	Volcanic and sedimentary deposits, unconformably overlain on the Witwatersrand Supergroup. The Klipriviersberg Group comprises lava and tuff, while the Platberg Group consists of clastic and chemical sediments.
Witwatersrand Supergroup Quartzite	1130	Quartzite, conglomerate and subordinate shale that hosts gold-bearing reefs. Central Rand Group quartzites are prevalent in the project area.
Notes: Lithology descriptions after iLEH (2017)		

8.1.2.2 LOCAL GEOLOGY

According to the 1:250 000 geological maps (2826: Winburg), a large portion of the study area's surficial geology comprises aeolian sands and quaternary deposits as shown in Figure 10. Isolated patches within the study area are also covered by alluvial sand deposits which is mainly associated with the Sand and Doringriver floodplains and constrained by drainage patterns and riparian zones. The site is underlain by the Adelaide Subgroup (Vpa) consisting of alternating layers of bluish-grey, greenish-grey or greyish-red mudrock and grey, very fine to medium-grained, lithofeldspathic sandstone, the Vryheid Formation (Pv) which consists mainly of fine grained mudstone, carbonaceous shale with alternating and coarse grained, bioturbated immature sandstones respectively as well as the Volksrust Formation (PVo) which consists of grey to black, silty shale with thin, usually bioturbated, siltstone or sandstone lenses and beds, particularly towards its upper and lower boundaries. The Dwyka Group consists mainly of diamictite (tillite) which is generally massive with little jointing, but it may be stratified in places. Various historical and recently drilled exploration boreholes were utilised in order to gather site specific geological data (refer to Figure 11). The geological database, summarising the local stratigraphical sequence, was applied to incorporate site specific geological information into the conceptual and numerical groundwater model development as shown in Figure 12, Figure 13 and Figure 14.

8.1.2.3 STRUCTURAL GEOLOGY

Large dolerite intrusions in the form of dykes and sills are observed throughout the study area as depicted in **Error! Reference source not found.**. The Karoo sediments in this portion of the WMA are much intruded by sub accordant sheets, and to a lesser extent by near-vertical dykes of Karoo dolerite (DWAF, 2004). The Karoo Basin is characterised by a vast network of post-Karoo intrusive dolerite (Jd) sills and dykes that rapidly intruded at 183.0 to 182.3Ma (H. Svensen, 2012). The intrusive Karoo dolerite suite represents a shallow feeder system which occurs as an interconnected network of dykes, sills as well as sheets which typically form resistant caps of hills compromising softer sedimentary strata (Chevallier L., 1999). Exploration data evaluated suggest dykes are relatively thin, usually not wider than 5.0m while sills may be as thick as 100.0m. On a regional scale various dykes can be observed which may have an impact on the local hydrogeological regime as it can serve as potential

preferred pathways for groundwater flow and contaminant transport. Deep fault zones that will be targeted for gas production are associated with the Central Rand Group and Ventersdorp lavas.

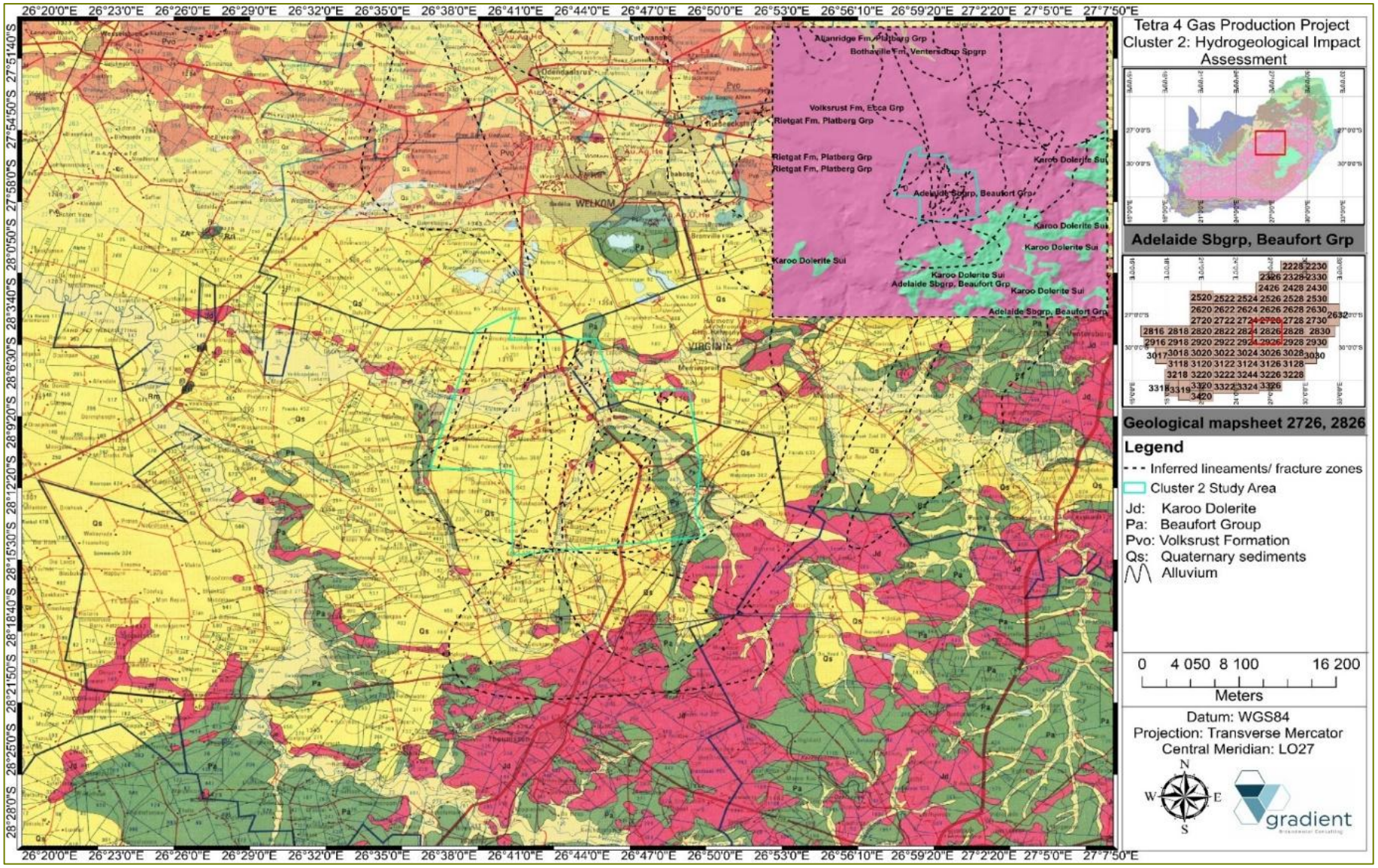


Figure 10: Regional geology and stratigraphy (Geological map sheet 2826: Winburg).

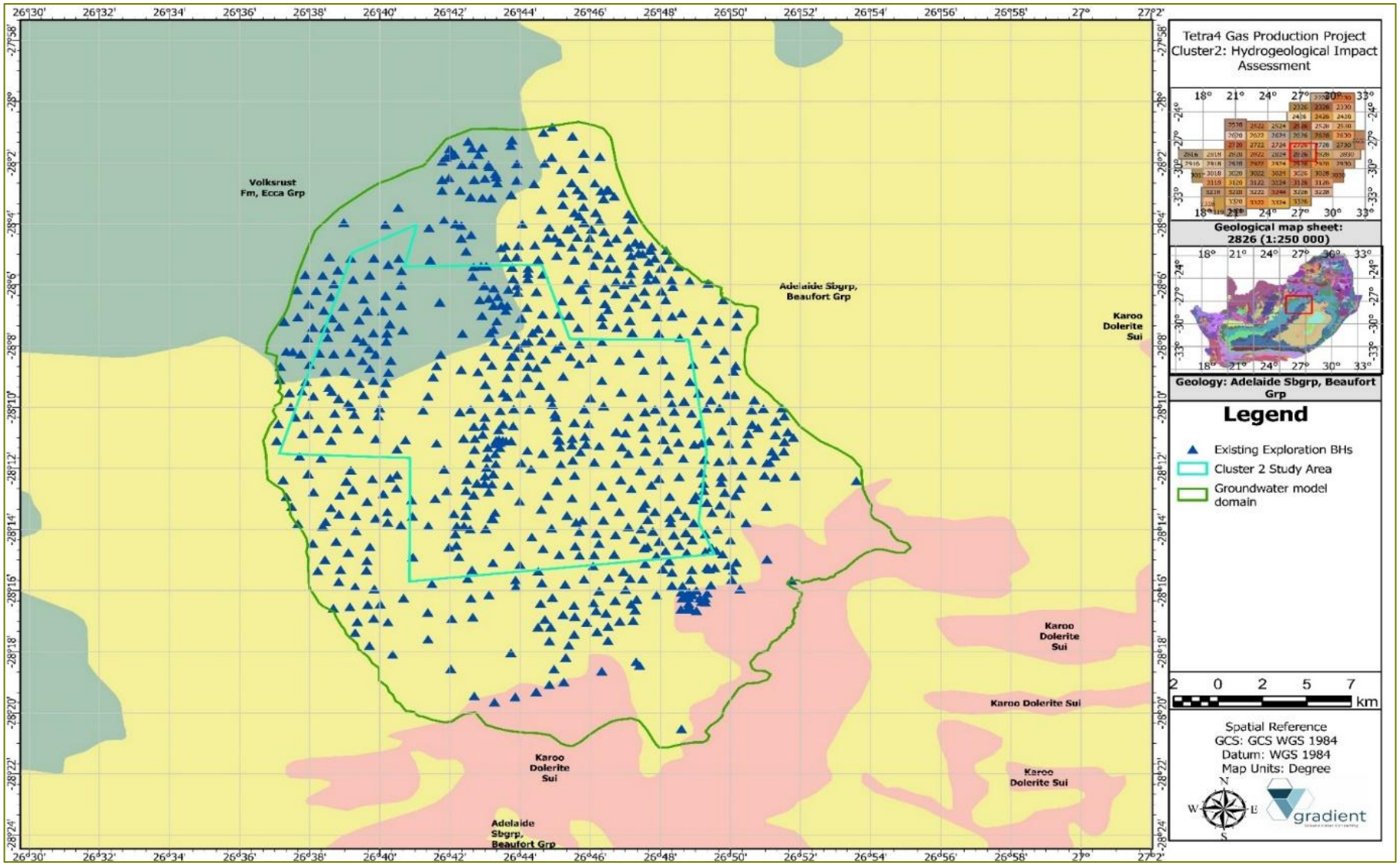


Figure 11: Spatial distribution map of regional geological exploration boreholes.

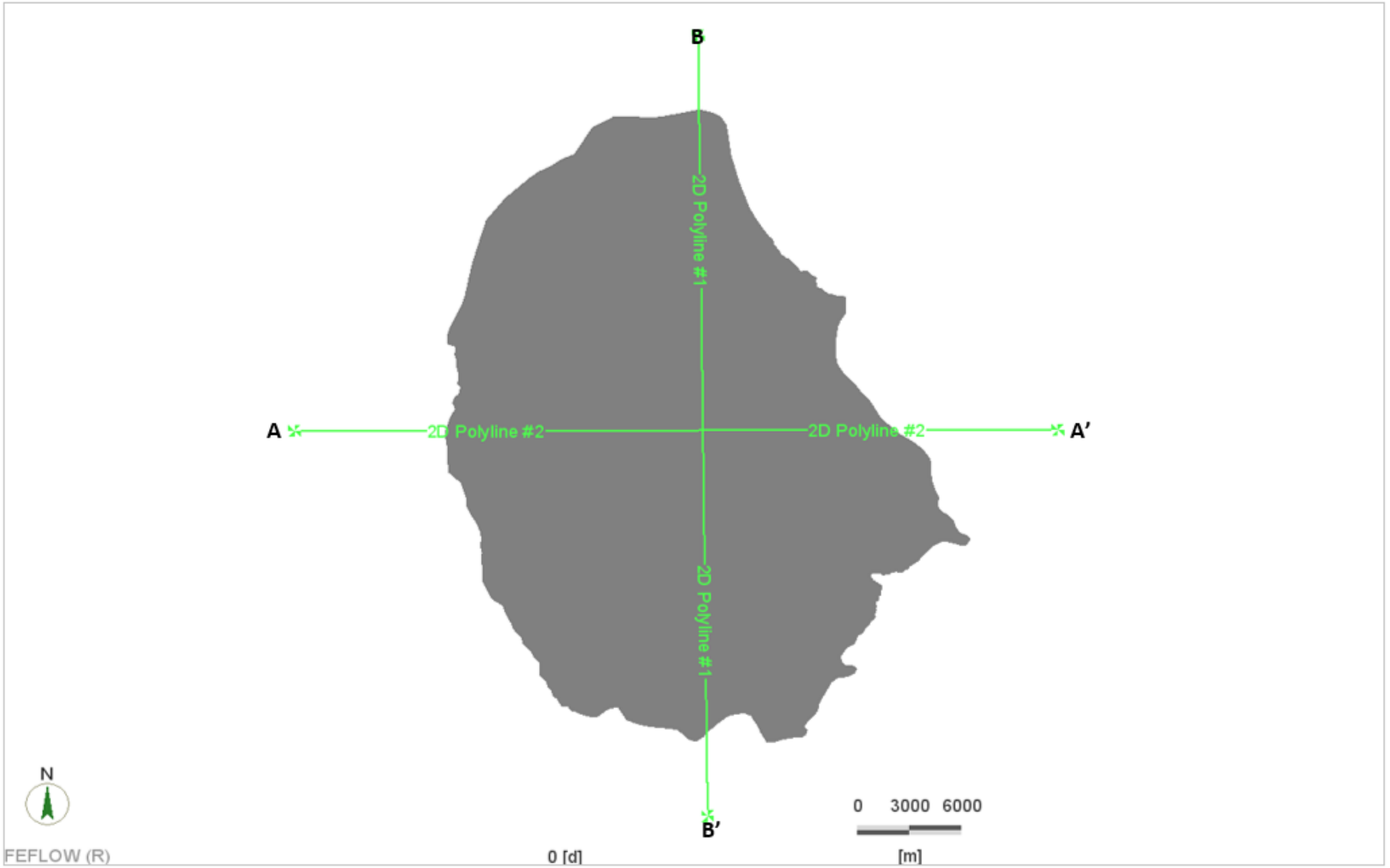


Figure 12: Plan view of the modelled domain with relevant geological cross sections.

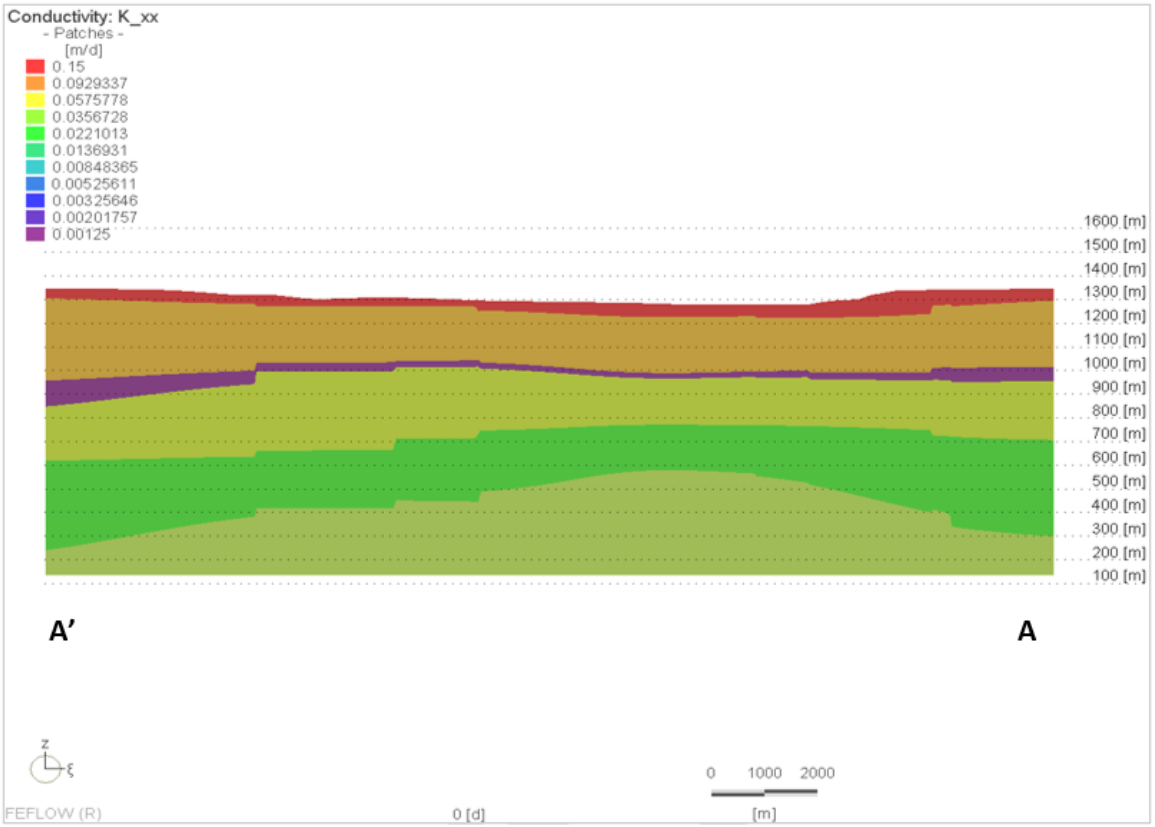


Figure 13: Model cross section A-A' depicting stratigraphical sequence.

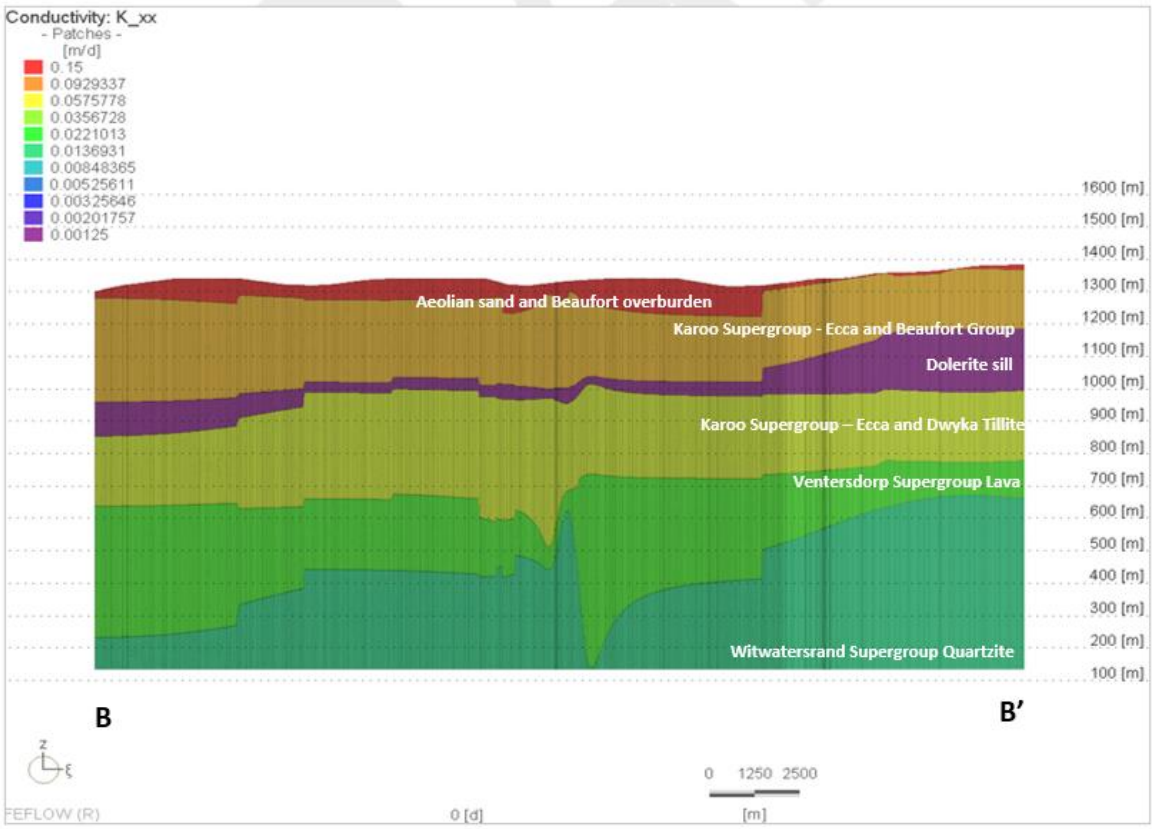


Figure 14: Model cross section B-B' depicting stratigraphical sequence.

8.1.2.4 **PALAEONTOLOGY**

The study area is situated within the Grassland Biome as defined by Rutherford and Westfall, and more specifically within the Central Free State Grassland vegetation type (Rutherford M. C., 1994) and (Mucina, 2006). This vegetation unit is characterised by a dominance of perennial C_4 grasses with a generally low shrub and tree component, occurring on flat to gently undulating terrain under semi-arid climatic conditions. Typical species include *Themeda triandra, Eragrostis curvula*, and *Aristida spp*., with local variation influenced by soil depth, grazing pressure, and land-use history (Mucina, 2006). Much of the natural vegetation in the area has been transformed or degraded by agriculture, grazing, and associated infrastructure, resulting in secondary grassland and disturbed vegetation along access routes (Rutherford M. &., 1994).

The topography of the project area and surrounding landscape is generally flat to gently undulating, characteristic of the central Free State interior plateau (Partridge, 2010). Elevation changes are subtle, with broad plains locally dissected by shallow drainage lines and minor seasonal watercourses. Slopes are generally low and uniform, and no prominent ridgelines or steep terrain features occur along the proposed access road alignment. This subdued relief reflects long-term erosional processes acting on relatively homogeneous sedimentary geology and underpins the dominance of extensive agricultural land use across the region (Partridge, 2010).

8.1.2.4.1 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Tetra4 3D Seismic Survey Project near Virginia, in the Free State Province is indicated on the 1: 250 000 Winburg 2826 Geological Map (Council for Geosciences, Pretoria). The proposed development is underlain by Quaternary alluvium (yellow, single bird figure), Superficial sands (Qs, yellow) the Jurassic dolerite of the Karoo Igneous Province (Jd, red) as well as the Adelaide Subgroup of the Karoo Supergroup (Pa, green) (Figure 4, Table 2). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of Quaternary sediments is Moderate (green), that of the Karoo Igneous Suite is Zero (grey), while that of the Adelaide Subgroup (Beaufort Group) is Very High (red) (Almond J. P., 2013), (Almond J. P., 2013); and (Groenewald, 2014). Palaeontological Sensitivity generated by the Department of Forestry, Fisheries and the Environment National Environmental Web-Based (DFFE) Screening Tool indicates a Very High Palaeontological Sensitivity (deep red, Figure 6). No Site investigation was conducted for this project, but is recommended in this report. Recent research has indicated that the Adelaide Subgroup is represented by the Balfour Formation.

Underlying the superficial deposits are sedimentary rocks of the Adelaide Subgroup (Beaufort Group), consisting predominantly of sandstones, mudstones, and shales deposited in fluvial environments. The Beaufort Group represents the third major subdivision of the Karoo Supergroup, overlying the Ecca Group, and was deposited from the Middle Permian to the early Middle Triassic. It constitutes the first fully continental succession of the Karoo Basin and covers approximately 200 000 km² in South Africa. The Beaufort Group is subdivided into the lower Adelaide Subgroup and the overlying Tarkastad Subgroup (Figure 8). Sedimentation within the Adelaide Subgroup occurred under humid climatic conditions on wet floodplains with high water tables and is interpreted as fluvio-lacustrine in origin. The subgroup reaches thicknesses of up to 5 000 m in the southeastern Karoo Basin, thinning to approximately 800 m in the basin centre and to 100–200 m toward the northern margins.

The Adelaide Subgroup is characterised by alternating greyish-red, bluish-grey, and greenish-grey mudrocks interbedded with very fine- to medium-grained lithofeldspathic sandstones. Thicker sandstone units are commonly multistorey and exhibit cut-and-fill architectures. Internal sedimentary structures include horizontal lamination, parting lineation, trough cross-bedding, and ripple lamination, with ripples typically confined to thinner sandstones near the tops of thicker units. Mudrocks generally weather to massive, blocky forms and may preserve desiccation cracks and raindrop impressions. Calcareous nodules and concretions are widespread throughout Beaufort Group mudstones.

The floodplain deposits of the Beaufort Group are internationally renowned for documenting the early diversification of terrestrial vertebrates and provide the most complete fossil record globally of the transition from early reptiles to mammals. The Beaufort Group is subdivided into a series of vertebrate assemblage zones based on faunal content (Kitching, 1977), (Keyser, 1977), (Rubidge, 1995), (Smith et al., 2020), (Viglietti, 2020).

A portion of the proposed development area is underlain by the Balfour Formation, which falls within the Daptocephalus Assemblage Zone (DAZ). This Assemblage Zone is further subdivided into the lower Dicynodon–Theriognathus Subzone and the upper Lystrosaurus maccaigi–Moschorhinus kitchingi Subzone.

The dicynodont Daptocephalus leoniceps is the index fossil defining the Daptocephalus Assemblage Zone. This Assemblage Zone is characterised by the co-occurrence of Daptocephalus leoniceps, the therocephalian Theriognathus microps, and the cynodont Procynosuchus delaharpeae. The lower Dicynodon–Theriognathus Subzone contains Dicynodon and Theriognathus in association with Daptocephalus, while the upper Lystrosaurus maccaigi–Moschorhinus kitchingi Subzone is defined by the presence of Lystrosaurus maccaigi, Daptocephalus, and Moschorhinus. The Daptocephalus Assemblage Zone displays the highest vertebrate diversity within the Beaufort Group and includes numerous well-preserved dicynodonts, biarmosuchians, gorgonopsians, therocephalians, and cynodont therapsids. Captorhinid reptiles are also present, while eosuchian reptiles, amphibians, and fish are comparatively rare. Trace fossils and Glossopteris flora have also been documented.

The Daptocephalus Assemblage Zone extends into the lower Palingkloof Member of the Upper Balfour Formation. This interval is of particular significance as it immediately precedes the Permo–Triassic mass extinction event, which resulted in the collapse of terrestrial vertebrate ecosystems and the extinction of glossopterid plant communities. The overlying Lystrosaurus declivis Assemblage Zone forms part of the Katberg Formation and records a marked reduction in faunal diversity. Fossil assemblages from this interval are dominated by Lystrosaurus and Procolophon, with reduced representation of other therapsids. Large amphibians are characteristic of this interval, and fossil fish, millipedes, and diverse trace fossils have also been recorded.

The study area (Figure 15) is partially underlain by rocks of the Karoo Igneous Province, one of the world's classic continental flood basalt provinces. This province comprises extensive intrusive and extrusive igneous rocks emplaced over a large area of southern Africa (Duncan, 2006). Flood basalts typically formed through repeated fissure eruptions, producing sub-horizontal lava flows, sills, and dykes of variable thickness rather than prominent volcanic edifices. These lavas once formed a near-continuous cap across much of southern Africa but are now preserved as erosional remnants. The present outcrop area of Karoo lavas is approximately 140 000 km², although they are estimated to have originally covered up to 2 000 000 km² (Cox, The extent and evolution of the Karoo Flood Basalt Province, 1970) and (Cox, Aspects of Karoo Volcanism, 1972)

In addition to basaltic lavas, the Karoo Igneous Province includes significant volumes of silicic volcanic rocks composed of rhyodacitic and rhyolitic magmas, particularly along the Lebombo monocline. Individual silicic units may extend for up to 60 km and often display massive pyroclastic textures, leading to their classification as rheoignimbrites. The basal lavas generally lie conformably on the Clarens Formation, although localised pre-volcanic erosion of Clarens sandstones has been documented. Early stages of volcanism involved interaction between magma and groundwater, resulting in volcaniclastic deposits and phreatic to phreatomagmatic diatremes (Lock et al., 1974). Additional evidence for aqueous environments during early volcanism includes pillow lavas, hyaloclastite breccias, and thin lenses of fluviatile sandstones interbedded with the lowermost lava flows (Eales et al., 1984). As igneous rocks, these units are unfossiliferous.

The Quaternary Period, often referred to as the "Age of Mammals," is preserved in South Africa across a range of depositional environments, including coastal plains (e.g. Langebaanweg), cave systems (e.g. Makapan), river gravel terraces (e.g. Cornelia), and other sedimentary basins. African Quaternary deposits are subdivided into six Land Mammal Ages: Recent, Florisian, Cornelian, Makapanian, Langebaanian, and Namibian (MacRae, 1999). In the Free State Province, Quaternary fossil assemblages are best documented from the Florisbad and Cornelia localities, where fossils include mammalian teeth and bones, fish, reptiles, freshwater molluscs, trace fossils, fossil wood, rhizoliths, and diatom floras (Groenewald G.H, 2014).

The Virginia–Welkom District is well known for fluvial deposits associated with present-day river systems. These terrestrial sediments include diatomite, calcareous tufa, pedocretes, peats, spring deposits, soils, gravels, and other Tertiary calcrete deposits, which are important for reconstructing Early to Late Pliocene environments in the region (De Ruiter, 2010). Late Cenozoic (Plio-Pleistocene) floodplain deposits and pan sites associated with the Sand, Doring, Vals, and Vet river systems have yielded confined but locally abundant vertebrate fossil

assemblages. In 1955, Meiring described an in-situ proboscidean fossil recovered from pebbly channel-fill sediments along the Sand River near Virginia, approximately 40 m above the modern riverbed. The specimen comprised a lower molar, part of a tusk, and a proximal portion of an ulna. Initially described as Archidiskodon scotti (Meiring, 1955), it was subsequently reassigned to the Pliocene species Mammuthus subplanifrons (Coppens, 1978). Later investigations documented a diverse associated fauna, including amphibians, birds, fish, reptiles, and several proboscideans, perissodactyl, and artiodactyl taxa (De Ruiter, 2010).

Terrace gravels above the Vet River southwest of Welkom have yielded Pliocene fossil material, while surveys along the Doring, Vals, Sand, and Vet rivers recorded moderately fossiliferous overbank sediments and erosional gullies containing a variety of Quaternary-aged mammal fossils (Brink et al., 1999; (De Ruiter D.J., 2011). Ancient pan sites, such as those near Whites, have produced rich Quaternary mammal assemblages. Although Quaternary fossils are generally rare and discontinuous, they may include mammalian teeth and bones, ostrich eggshell fragments, tortoise remains, ostracods, diatoms, reptile skeletons, and a range of trace fossils, including burrows, vertebrate tracks, rhizoliths, and calcretised termite mounds. Plant remains may include leaves, seeds, wood fragments, and pollen. Microfossils and vertebrate remains are most commonly associated with Quaternary deposits near drainage lines and watercourses.

The superficial deposits represent the youngest geological materials, formed during approximately the last 2.6 million years. These deposits are typically unconsolidated and consist of clay, gravel, sand, and silt, occurring as thin, discontinuous patches or more extensive sedimentary spreads. They include channel, floodplain, stream, talus, and glacial drift deposits. Quaternary sediments are of particular scientific importance as they record palaeoclimatic fluctuations and associated geomorphological changes. Most present-day landforms in southern Africa developed during the Quaternary in response to alternating climatic conditions (Hunter, 2006) and (Maud, 2012). Barnosky (2005) demonstrated that Quaternary climate variability, particularly over the last 1.8 million years, was more pronounced than during earlier periods, resulting in significant changes in river dynamics, sedimentation patterns, and vegetation distribution (Tooth, 2004).

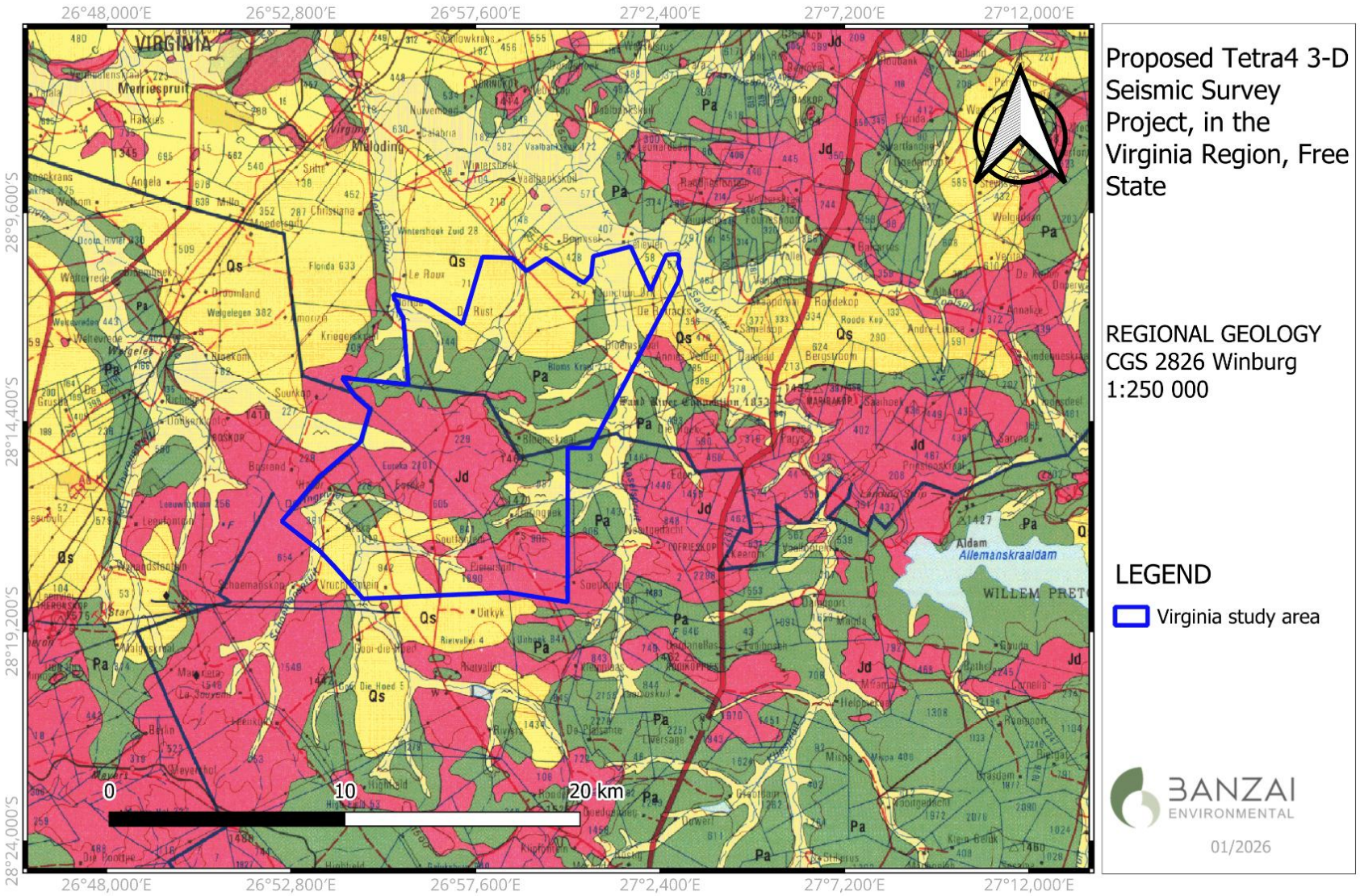


Figure 15: Extract of the 1:250 000 000 Winburg 2826 Geological Map (Council for Geosciences, Pretoria) indicates that the study area is underlain by Quaternary alluvium (yellow, single bird figure), Quaternary sand (Qs, yellow), Dolerite (Jd, red; Karoo Igneous Province) as well as the Adelaide Subgroup (Beaufort Group, Karoo Supergroup).

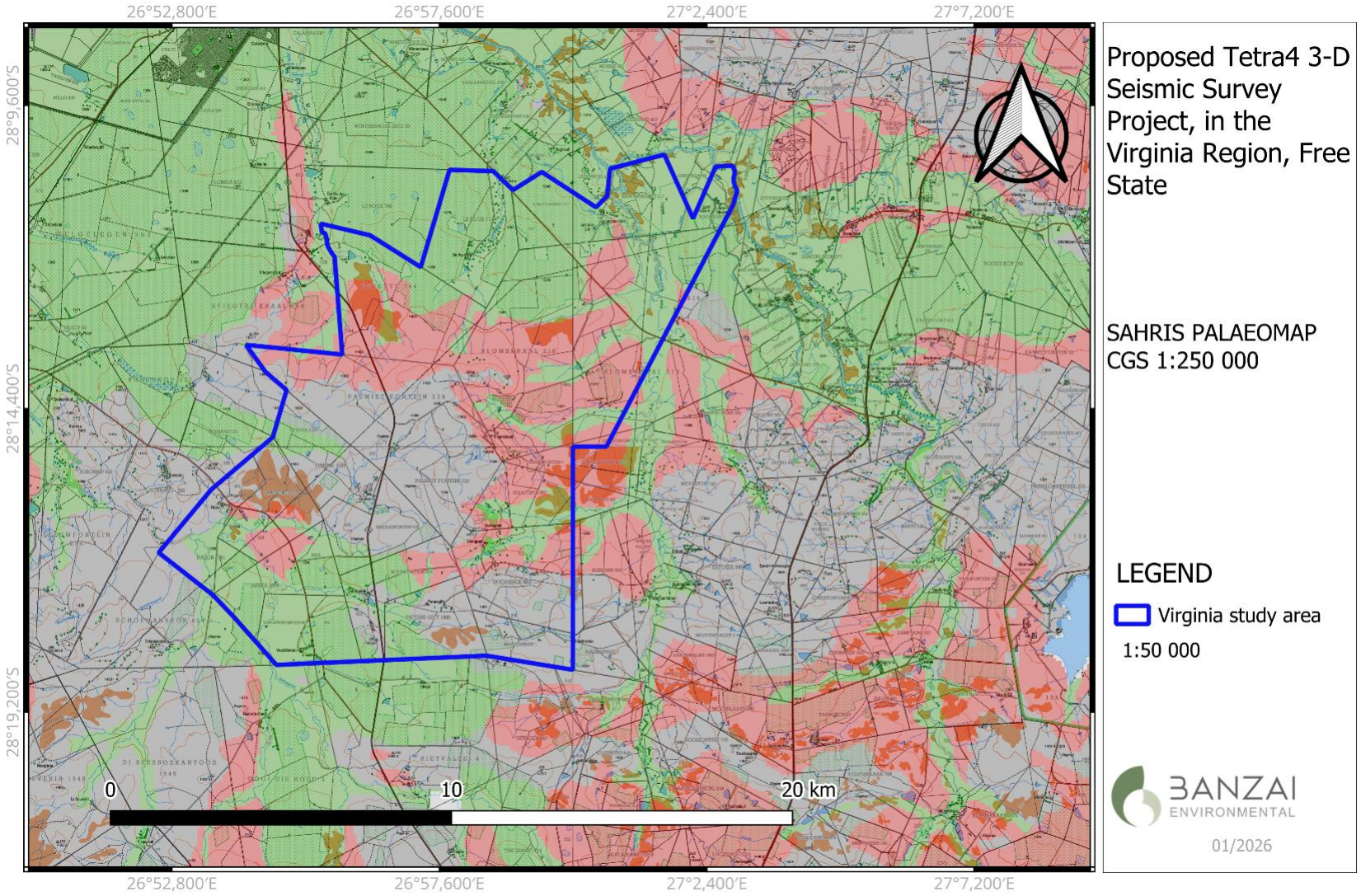


Figure 16: Extract of the SAHRIS PalaeoMap (Council for Geosciences, Pretoria) indicates that the study area is underlain by sediments with a Very High (red), Moderate (green) and Zero (grey) Palaeontological Sensitivity.

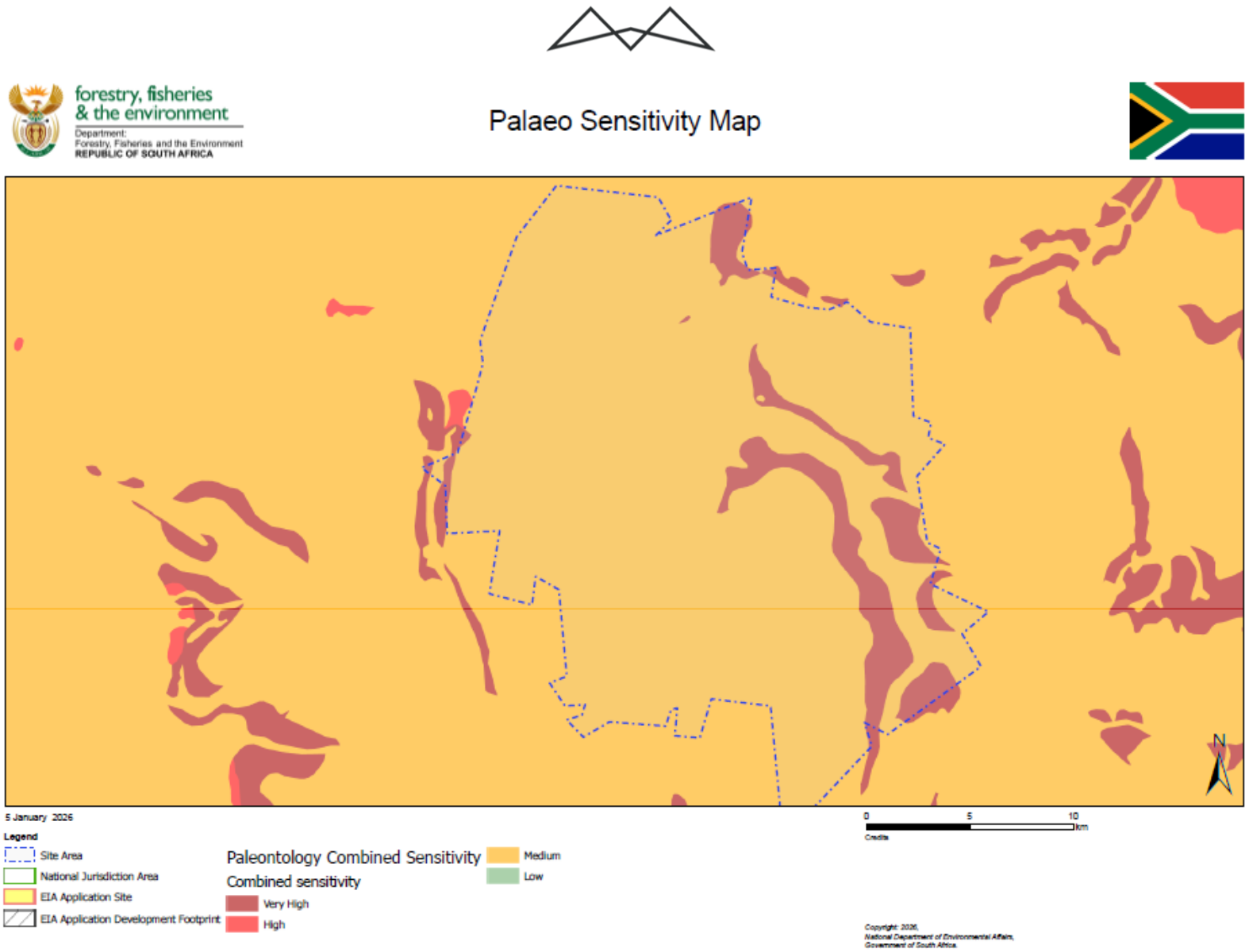


Figure 17: Palaeontological Sensitivity of the study area by the National Environmental Web-based Screening Tool indicates a Very High (deep red) Sensitivity, while areas with a Medium (yellow) is also crossed.

8.1.2.4.2 SAHRIS PALAEOMAP AND THE NATIONAL WEB-BASED SCREENING TOOL

Table 16: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website.

Colour	Sensitivity	Required Action
RED	Very High	Field assessment and protocol for finds are required
ORANGE/YELLOW	High	A desktop study is required, and based on the outcome of the desktop study, a field assessment is likely.
GREEN	Moderate	A desktop study is required
BLUE	Low	No palaeontological studies are required; however, a protocol for finds is required.
GREY	Insignificant/Zero	No palaeontological studies are required
WHITE/CLEAR	Unknown	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

The overall Palaeontological Sensitivity of the area is classified as Very High, as indicated by the SAHRIS Palaeomap (Figure 16 and Table 16).

The SAHRIS PalaeoMap (red, Figure 16 and Table 16) and the National Environmental Web-based Screening Tool (deep red, Figure 17) both classify the development area as having Very High Palaeontological Sensitivity.

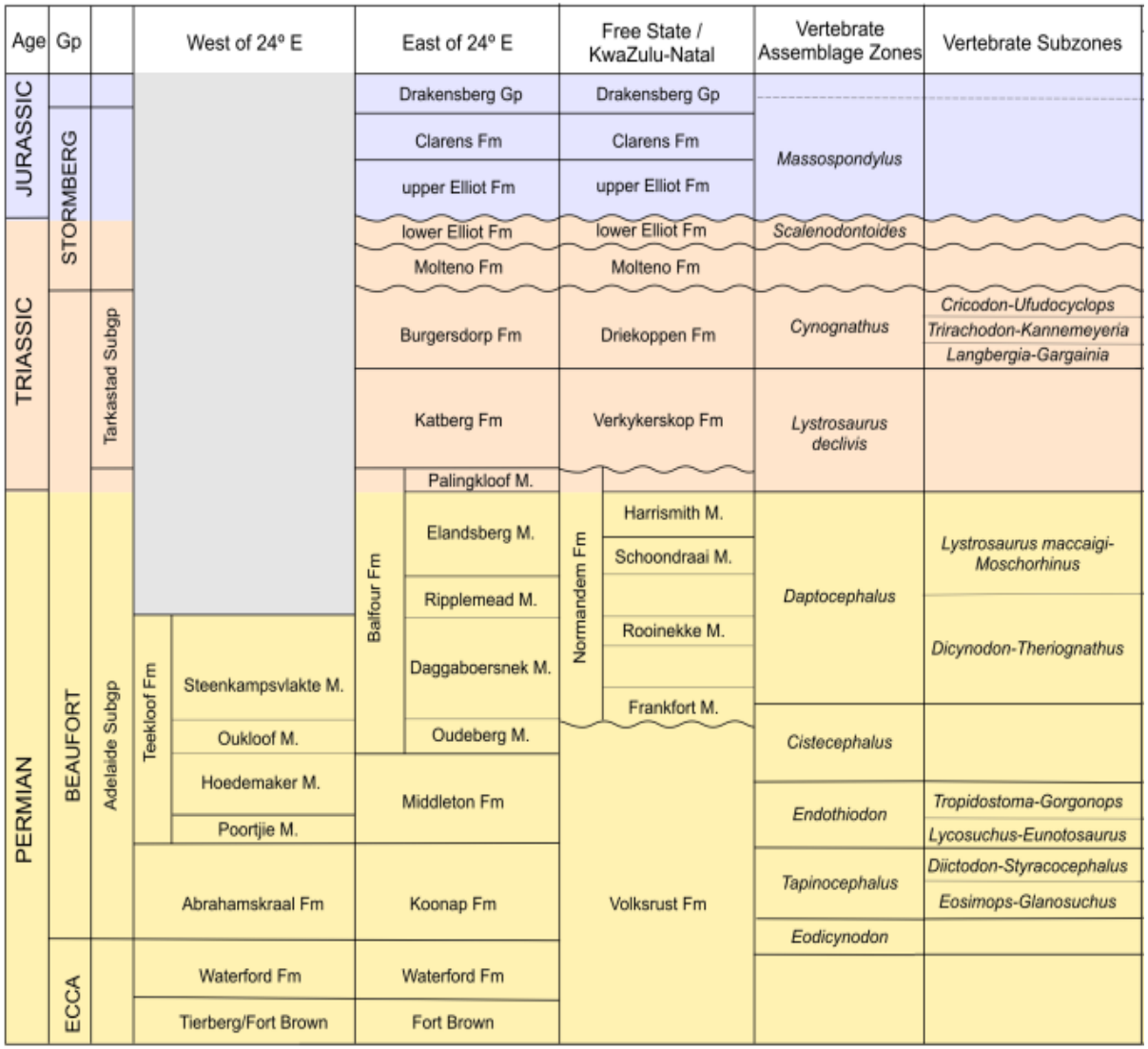


Figure 18: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa.

Solid lines indicate known ranges, dotted lines indicate suspected but not confirmed ranges, single dot represents the stratigraphic position of the taxa that have only been recovered from a single bed. Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMFMES+Mammaliaformes. Gp=group, Subgp-Supbroup, Fm=Formation, M=Member. The proposed development is indication by the red polygon (Figure 18).

The proposed development is underlain by Quaternary alluvium (yellow, single bird figure), Superficial sands (Qs, yellow) the Jurassic dolerite of the Karoo Igneous Province (Jd, red) as well as the Adelaide Subgroup of the Karoo Supergroup (Pa, green) (Figure 4, Table 2). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of Quaternary sediments is Moderate (green), that of the Karoo Igneous Suite is Zero (grey), while that of the Adelaide Subgroup (Beaufort Group) is Very High (red) (Almond and Pether, 2009; Almond et al., 2013, Groenewald et al 2014). Palaeontological Sensitivity generated by the Department of Forestry, Fisheries and the Environment National Environmental Web-Based (DFFE) Screening Tool indicates a Very High Palaeontological Sensitivity. No Site investigation was conducted for this project, but is recommended in this report. Recent research has indicated that the Adelaide Subgroup is represented by the Balfour Formation.

8.1.3 SOILS AND LAND CAPABILITY

8.1.3.1 **SOIL CLASSIFICATION**

According to the land type database (Land Type Survey Staff, 1972 - 2006) the assessment corridor to be focused on falls within the Ae40, Bd20, Dc8, Dc9 and Dc12 land types. The Ae land type mostly consist of apedal (yellow/red), duplex soils characterised with high clay contents and shallow profiles associated with partially weathered/ un-weathered material with the possibility of other soils occurring throughout. Lime is generally present in low-lying areas. The Bd land type consists of mostly apedal and duplex soils with miscellaneous land classes including rocky areas with Mispah and Oakleaf soils forms according to the SA soil classification working group (1990). The Dc land types is characterised with duplex, transitional young alluvial soil deposits with occasional red soils, some saturated profiles, shallow soils, and intrusive hard rocks. The terrain units and expected soils for the Ae40 land type is illustrated in Figure 19 and Table 17 respectively. Similarly, those for the Bd20 land type is depicted in Figure 20 and Table 18; Dc8 land type in Figure 21 and Table 19, Dc9 land type in Figure 22 and Table 20 and Dc12 in Figure 23 and Table 21 respectively.

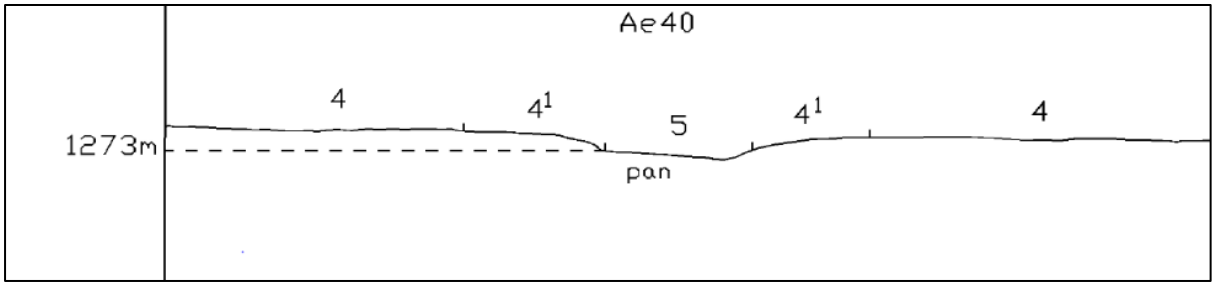


Figure 19: Illustration of land type Ae40 terrain unit (Land Type Survey Staff, 1972 - 2006).

Table 17: Soils expected at the respective terrain units within the Ae 40 land type (Land Type Survey Staff, 1972 - 2006).

Terrain Units					
4 (92%)		**4 (1) (4%)**		**5 (4%)**	
Hutton	89%	**Swartland**	25%	**Katspruit, Rensburg**	75%
Clovelly	7%	**Mispah**	50%	**Swartland**	25%
Bainsvlei	2%	**Oakleaf**	25%		

Terrain Units					
4 (92%)		4 (1) (4%)		5 (4%)	
Avalon	2%				

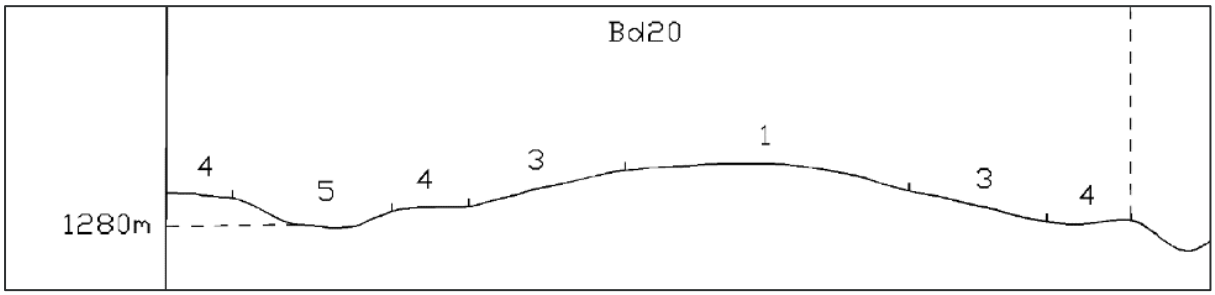


Figure 20: Illustration of land type Bd 20 terrain unit (Land Type Survey Staff, 1972 - 2006).

Table 18: Soils expected at the respective terrain units within the Bd 20 land type (Land Type Survey Staff, 1972 - 2006)

Terrain Units							
1 (55%)		3 (40%)		4 (3%)		5 (2%)	
Clovelly	65%	Clovelly	45%	Hutton	50%	Valsrivier	55%
Avalon	30%	Avalon	20%	Valsrivier	18%	Arcadia, Rensburg	30%
Arcadia, Rensburg	1%	Hutton	25%	Avalon	10%	Oakleaf	10%
Katspruit	1%	Valsrivier	8%	Clovelly	5%	Katspruit	10%
Valsrivier	3%	Arcadia, Rensburg	1%	Oakleaf	5%		
		Katspruit	1%	Arcadia, Rensburg	1%		

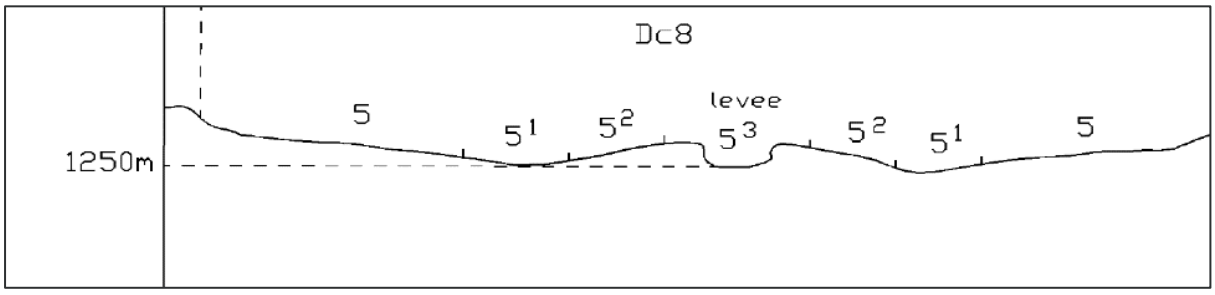


Figure 21: Illustration of land type Dc 8 terrain unit (Land Type Survey Staff, 1972 - 2006).

Table 19: Soils expected at the respective terrain units within the Dc 8 land type (Land Type Survey Staff, 1972 - 2006).

Terrain Units							
5 (44%)		**5(1) (40%)**		**5 (2) 27%)**		**5 (3) (16%)**	
Arcadia	42%	**Arcadia**	41%	**Oakleaf**	66%	**Dundee**	7%
Valsrivier	48%	**Rensburg**	59%	**Valsrivier**	32%	**Stream beds**	28%
Sterkspruit	6%			**Stream beds**	2%	**Fernwood**	22%
Katspruit	1%					**Oakleaf**	13%
Bonheim	4%						

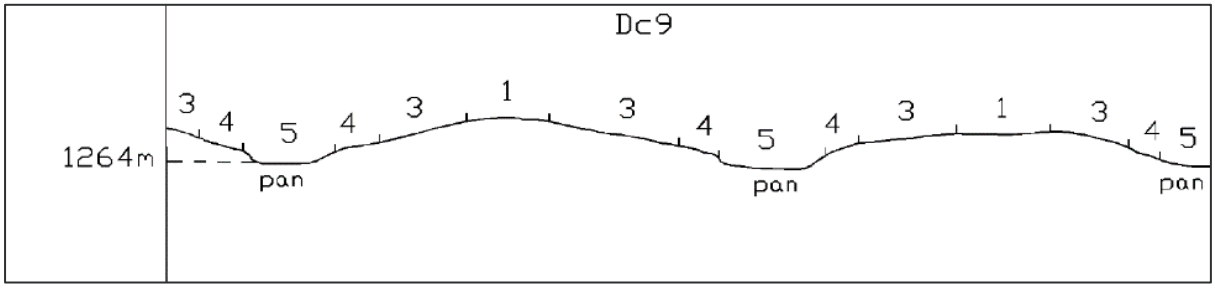


Figure 22: Illustration of land type Dc 9 terrain unit (Land Type Survey Staff, 1972 - 2006).

Table 20: Soils expected at the respective terrain units within the Dc 9 land type (Land Type Survey Staff, 1972 - 2006).

Terrain Units							
1 (10%)		**3 (27%)**		**4 (41%)**		**5 (22%)**	
Hutton	100%	**Hutton**	88%	**Swartland**	28%	**Willowbrook**	91%
		Clovelly	11%	**Valsrivier**	24%	**Valsrivier**	5%
		Oakleaf	1%	**Oakleaf**	23%	**Arcadia**	2%
				Sterkspruit	17%	**Sterkspruit**	1%
				Arcadia	4%	**Mispah**	1%
				Estcourt	3%		
				Mispah	1%		

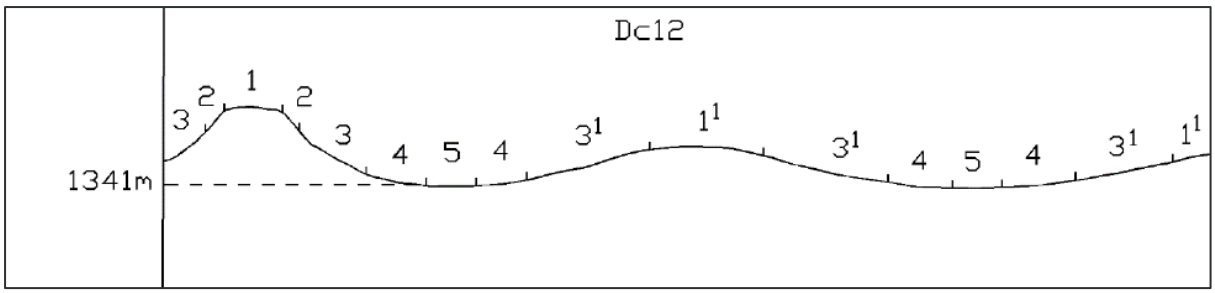


Figure 23: Illustration of land type Dc 12 terrain unit (Land Type Survey Staff, 1972 - 2006).

Table 21: Soils expected at the respective terrain units within the Dc 12 land type (Land Type Survey Staff, 1972 - 2006).

Terrain Units													
1 (3%)		**1 (1) (20%)**		**2 (1%)**		**3 (6%)**		**3 (1) (38)**		**4 (24)**		**5 (8)**	
Rocks	33%	**Mispah**	37%	**Rocks**	60%	**Rocks**	33%	**Swartland**	34%	**Bonheim**	29%	**Oakleaf**	41%
Mayo	23%	**Swartland**	19%	**Mispah**	30%	**Mayo**	25%	**Mispah**	18%	**Swartland**	27%	**Katspruit**	27%
Mispah	21%	**Glenrosa**	13%			**Swartland**	17%	**Bonheim**	14%	**Valsrivier**	15%	**Stream beds**	13%
Glenrosa	13%	**Westleigh**	12%			**Mispah**	17%	**Valsrivier**	9%	**Arcadia**	15%	**Valsrivier**	6%
Swartland	10%	**Mayo**	6%	**Glenrosa**	10%	**Glenrosa**	8%	**Glenrosa**	7%	**Sterkspruit**	4%	**Bonheim**	5%
		Bonheim	5%					**Arcadia**	7%	**Mispah**	4%	**Glenrosa**	4%
		Valsrivier	3%					**Westleigh**	5%	**Mayo**	3%	**Mayo**	4%
		Rocks	3%					**Mayo**	3%	**Glenrosa**	2%		
		Hutton	2%					**Hutton**	2%	**Rocks**	1%		

Soil profiles were studied up to a depth of 1.2 m to identify specific diagnostic horizons which are vital in the soil classification process as well as determining the agricultural potential and land capability. Considering the large scale of the project area, only the most sensitive soil forms have been considered. The following diagnostic horizons were identified during the site assessment (also see Figure 24)

Table 22: diagnostic soil horizons identified during the site assessment.

Diagnostic soil horizons	Description
Orthic topsoil;	Orthic topsoils are mineral horizons that have been exposed to biological activities and varying intensities of mineral weathering. The climatic conditions and parent material ensure a wide range of properties differing from one Orthic A topsoil to another (i.e. colouration, structure etc) (Soil Classification Working Group, 2018).
Gley horizon;	Gley horizons that are well developed and have homogenous dark to light grey colours with smooth transitions. Stagnant and reduced water over long periods is the main factor responsible for the formation of a gley horizon and could be characterised by green or blue tinges due to the presence of a mineral called Fougerite which includes sulphate and carbonate complexes. Even though grey colours are dominant, yellow and/or red striations can be noticed throughout a gley horizon. The structure of a gley horizon mostly is characterised as strong pedal, with low hydraulic conductivities and a clay texture, although sandy gley horizons are known to occur. The gley soil form commonly occurs at the toe of hillslopes (or benches) where lateral water inputs (sub-surface) are dominant and the underlaying geology is characterised by a low hydraulic conductivity. The gley horizon usually is second in diagnostic sequence in shallow profiles yet is known to be lower down in sequence and at greater depths (Soil Classification Working Group, 2018).
Soft Plinthic horizons;	The accumulations of iron (and in some cases manganese) as hydroxides and oxides with the presence of high chroma striations and concretions with black matrixes are associated with the Soft Plinthic horizon. This diagnostic horizon forms due to fluctuating levels of saturation. The iron and manganese concentration result in soft marks within the soil matrix which transform in concretions with high consistencies (Soil Classification Working Group, 1991). If this process continues for long enough periods, a massive continues impermeable layer of hard plinthite forms. A Soft Plinthic horizon and a Hard Plinthic horizon can be distinguished from one another by means of a simple spade test. A Soft Plinthic horizon can be penetrated by means of a spade in wet conditions whereas a Hard Plinthic horizon cannot (Soil Classification Working Group, 1991). According to Soil Classification Working Group (2018), this horizon commonly occurs as a result of hillslope hydrology in flat, sandy landscapes. This horizon is known to have an apedal structure together with the presence of concretions.
Lithocutanic horizon;	For the lithocutanic horizon, in situ weathering of rock underneath a topsoil results in a well-mixed soil-rock layer. The colour, structure and consistency of this material must be directly related to the parent material of the weathered rock. The Lithocutanic horizon is usually followed by a massive rock layer at shallow depths. Hard rock, permeable rock and horizontally layered shale usually is not associated with the weathering processes involved with the formation of this diagnostic horizon.

Diagnostic soil horizons	Description
Red apedal horizon; and	The red apedal diagnostic soil horizon has no well-formed peds, but rather small porous aggregates. The poor structure associated with this diagnostic profile is a result of weathering processes under well drained oxidising conditions. Iron-oxide precipitations form on the outside of soil particles (hence the red colour) and non-swelling clays dominate the clay particles. This diagnostic soil horizon is widely spread across South Africa and can be associated with any parent material expected (Soil Classification Working Group, 1991).
Yellow-brown apedal horizon.	The yellow-brown apedal horizon is similar to that of the Red Apedal horizon in all aspects except for the colour and the iron-oxide processes involved with the colouration thereof. This diagnostic soil horizon rarely occurs in parent rock high in iron-oxides and will rather be associated with Quartzite, Sandstone, Shale and Granites.

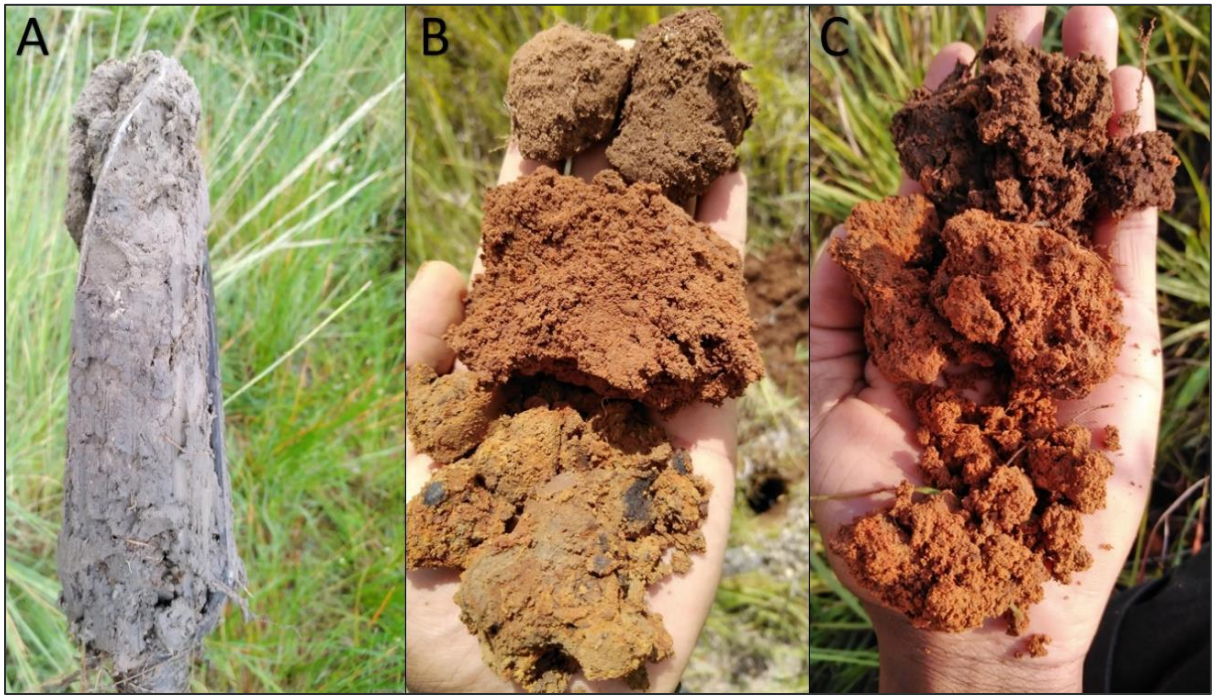


Figure 24: Dominant soils identified during the site assessment. A) Gley horizon. B) Orthic on top of yellow-brown apedal, underlined by soft-plinthite (Avalon). C) Orthic on top of red apedal horizon.

During the site assessment various soil forms were identified. These soil forms are described in Table 23 according to depth, clay percentage, indications of surface crusting, signs of wetness and percentage rock. The soil forms are followed by the soil family and in brackets the maximum clay percentage of the topsoil. Soil family characteristics are described in Table 24

Table 23: Summary of soils identified within the project area.

	Topsoil					Subsoil A				Subsoil B			
	Depth (mm)	Clay (%)	Signs of wetness	Rock %	Surface crusting	Depth (mm)	Clay (%)	Signs of wetness	Rock %	Depth (mm)	Clay (%)	Signs of wetness	Rock %
Griffin 1120(15)	0-300	0-15	None	0	None	300-700	15-30	None	0	700-1200 (+)	15-30		
Avalon 1220(15)	0-300	0-15	None	0	None	300-700	15-35	None	0	700-1200 (+)	>35	Plinthic conditions	
Ermelo	0-300	0-15	None	0	None	300- 1 200 (+)	0-15	None	0	N/A			
Hydromorphic	0-300	0-15	None	0	None	300- 800	0-15	None	0	N/A			

Table 24: Description of soil family characteristics.

Soil Form/Family	Topsoil Colour	Base Status	Textural Contrast
Griffin 1120(15)	Dark Topsoil	Mesotrophic	Luvic
Avalon 1220(15)	Dark Topsoil	Mesotrophic	Luvic
Ermelo 1120(15)	Dark Topsoil	Mesotrophic	Luvic

8.1.3.2 **LAND CAPABILITY**

The land capability was determined by using the guidelines described in "The farming handbook" (Smith, 2006). The delineated soil forms were clipped into the four different slope classes (0-3%, 3-7%, 7-12% and >12%) to determine the land capability of each soil form. Accordingly, the most sensitive soil forms associated with the project area are restricted to land capability 3, 4 and 5 classes.

The following land potential levels have been determined;

- Land potentials level 6 (these land potential levels are defined as having restricted to very restricted potentials. Regular, moderate and/or severe limitations due to soil, slope, temperatures or rainfall. Non-arable. The sensitivity of these land potentials are characterised by a "Low Sensitivity").

Fifteen land capabilities have been digitised by (DAFF, 2017) across South Africa, of which eight potential land capability classes are located within the proposed footprint area's assessment corridor, including;

- Land Capability 1 to 5 (very low to low);
- Land Capability 6 to 8 (moderately low to moderate); and
- Land Capability 8 to 10 (moderate to moderate high).

The baseline findings and the sensitivities as per the Department of Agriculture, Forestry and Fisheries (DAFF, 2017) national raster file concur with one another. It therefore is the specialist's opinion that the land capability and land potential of the resources in the regulated area is characterised by "Low" to "Moderate High" sensitivities (see Figure 25), which conforms to the requirements of an agricultural compliance statement only.

Table 25: Land capability for the soils within the project area.

Land Capability Class	Definition of Class	Conservation Need	Use-Suitability	Land Capability Group	Sensitivity
3	Moderate limitations. Some erosion hazard	Special conservation practice and tillage methods	Rotation crops and ley (50%)	Arable	High
4	Severe limitations. Low arable potential.	Intensive conservation practice	Long term leys (75%)	Arable	Moderate
5	Water course and land with wetness limitations	Protection and control of water table	Improved pastures, suitable for wildlife	Grazing	Low

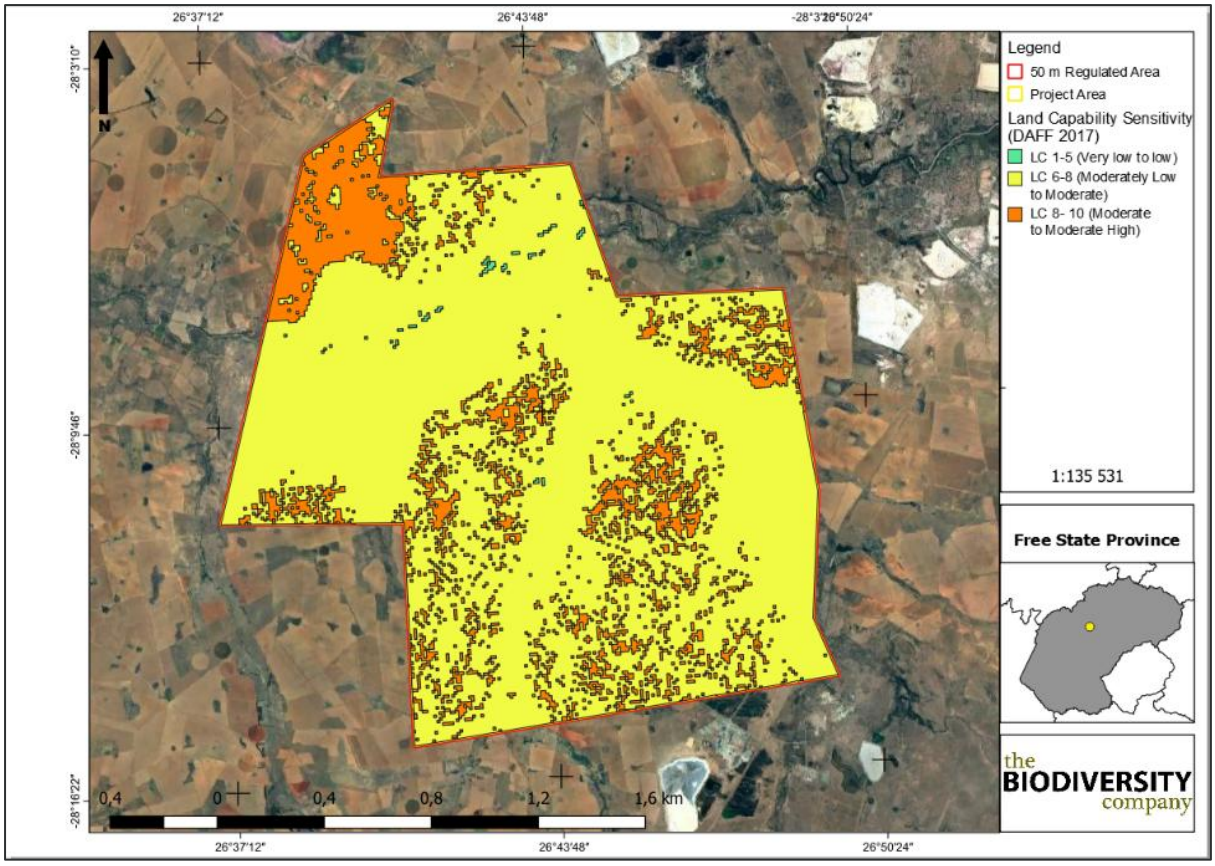


Figure 25: Land Capability Sensitivity (DAFF, 2017)

8.1.4 GROUNDWATER (GEOHYDROLOGY)

Gradient Groundwater Consulting conducted a geohydrological study as part of the Tetra4 Cluster 2 Virginia Gas Production EIA (2024/2025). While the proposed project activities are anticipated to have a minimal impact, the 2024/2025 report establishes the geohydrological baseline for the Cluster 2 Area. Specific to this report, it identifies the spatial distribution of existing boreholes. This data is essential for delineating safety buffers around poorly constructed boreholes, or those with uncased or degrading casings, to mitigate the risk of structural collapse or further degradation during vibroseis seismic surveys.

8.1.4.1 **HYDROCENSUS**

A hydrocensus user survey within the greater study area was conducted during March 2022 as well as in October 2024 where relevant hydrogeological baseline information was gathered. The aim of the hydrocensus survey is to determine the ambient and background groundwater conditions and applications and to identify potential sensitive environmental receptors, i.e., groundwater users in the direct vicinity of the gas production operations. A total of 171 geosites were visited and recorded which include surface water and groundwater receptors i.e. boreholes, artesian wells, wind pumps as well as surface water features were visited as part of the hydrocensus user survey which are largely applied for livestock watering and domestic water supply purposes. Relevant hydrocensus information is summarised in Table 26 (2022 hydrocensus user survey) and Table 27 (2024 hydrocenus user survey). Figure 30 depicts the spatial distribution of geosites visited as part of the hydrocensus user surveys while Figure 31 indicate the various groundwater status and applications.

Of the boreholes recorded, the majority are in use (~75.0%) while ~23.0% are not currently being utilized. Approximately 2.0% of boreholes allocated could not be visited due to access challenges. Most boreholes recorded are being applied for livestock watering and domestic water supply purposes (~35.0%) while domestic and household purposes which are combined with either irrigation or livestock purposes account for >16.0%. A small number of boreholes are also being applied for either monitoring or industrial purposes (~5.0%) while ~27.0% of boreholes do not have an application and are not currently being utilized. Refer to Figure 28 for a

summary of groundwater applications. According to the Middle Vaal ISP (DWAF, 2004), most boreholes are being applied for irrigation and small-town water supply.

Most boreholes visited are equipped with submersible pumps and account to 54.0%, while 18.0% of boreholes were fitted either with a wind pump, mono pump (2.0%), handpump (1.0%) or solar pump (1.0%). An average of 22.0% of boreholes are not equipped as indicated in Figure 29.

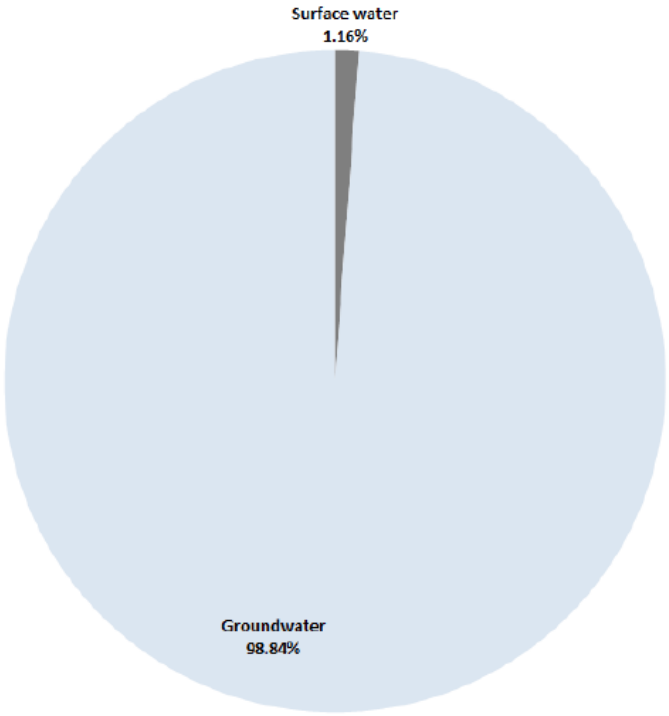


Figure 26: Hydrocensus user survey: Geosite type.

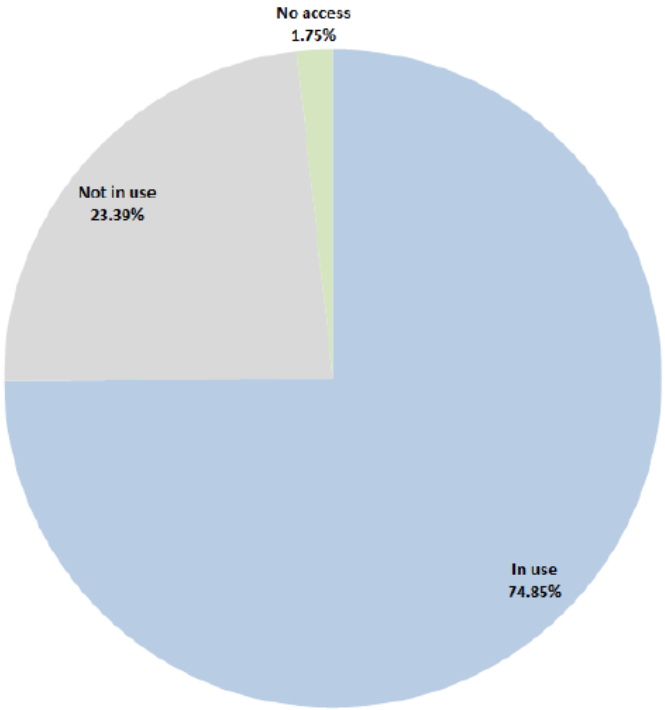


Figure 27: Hydrocensus user survey: Groundwater status.

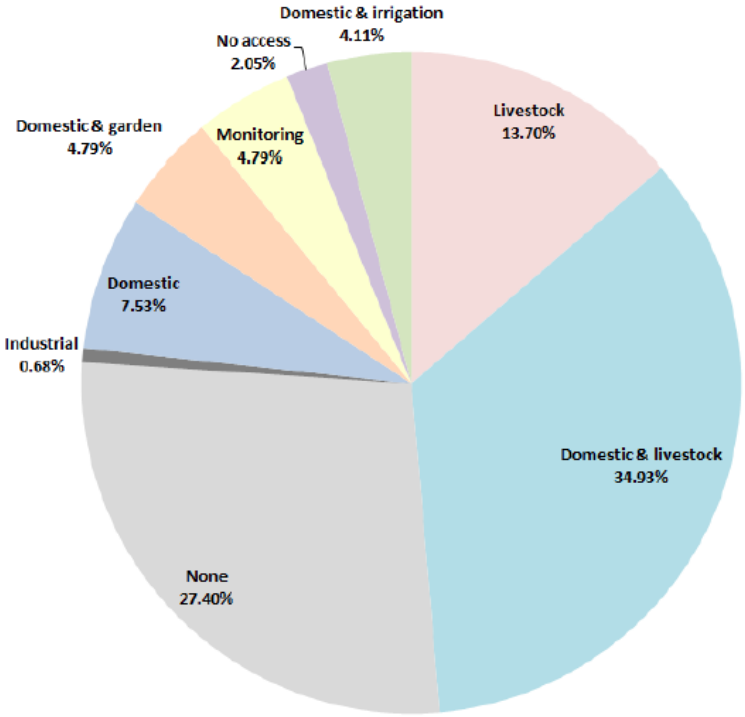


Figure 28: Hydrocensus user survey: Groundwater application.

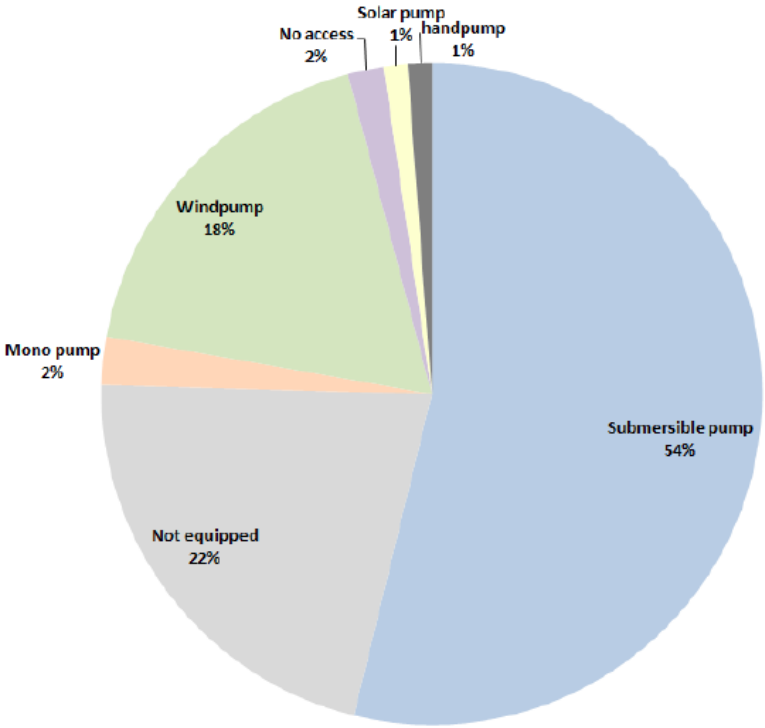


Figure 29: Hydrocensus user survey: Equipment type.

Table 26: Hydrocensus user survey - relevant information for geosites visited as part of the 2022 survey.

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH1	-28.14362	26.80863	NAWL		Borehole	In use	Submersible pump		Livestock	Flooded Area
HBH2	-28.12872	26.80516	NAWL		Borehole	In use	Windpump		Domestic & livestock	
HBH3	-28.12768	26.80522	NAWL		Borehole	In use	Submersible pump		Domestic & livestock	ROCLA
HBH4	-28.12407	26.80630	NAWL		Borehole	In use	Submersible pump		Domestic & livestock	ROCLA
HBH5	-28.11982	26.80036	NAWL		Borehole	In use	Submersible pump		Domestic & livestock	ROCLA
HBH6	-28.12005	26.79521	1.52	30	Borehole	In use	Submersible pump		Domestic & garden	
HBH7	-28.12940	26.77388	NAWL		Borehole	Not in use	No access		None	Blocked
HBH8	-28.15651	26.79403	NAWL		Borehole	In use	Submersible pump		Livestock	
HBH9	-28.15477	26.78428	10.87	30	Borehole	In use	Submersible pump		Livestock	
HBH10	-28.11906	26.81375	NAWL		Borehole	In use	Submersible pump		Industrial	ROCLA
HBH11	-28.11540	26.81199	NAWL		Borehole	In use	Submersible pump		Domestic	
HBH12	-28.13337	26.76153	13.65	30	Borehole	In use	Submersible pump		Domestic & livestock	
HBH13	-28.13200	26.76094	12.35	70	Borehole	In use	Submersible pump		Domestic & livestock	
HBH14	-28.12823	26.75381	16.65		Borehole	In use	Submersible pump		Domestic & livestock	
HBH15	-28.12852	26.75373	17.74		Borehole	In use	Submersible pump		Domestic & livestock	

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH16	-28.13105	26.75641	25.40	45	Borehole	In use	Submersible pump		Domestic & livestock	
HBH17	-28.12700	26.75455	11.55	40	Borehole	In use	Submersible pump		Domestic & livestock	
HBH18	-28.13405	26.75741	16.47	40	Borehole	Not in use	Not equipped		None	Open
HBH19	-28.13356	26.75760	NAWL		Borehole	In use	Submersible pump		Domestic & livestock	
HBH20	-28.08584	26.75406	1.10	70	Borehole	In use	Submersible pump		Domestic & livestock	
HBH21	-28.09424	26.73133	2.67		Borehole	Not in use	Not equipped		None	Open
HBH22	-28.11837	26.71244	NAWL		Borehole	Not in use	Not equipped		None	Closed
HBH23	-28.10725	26.70513	3.16	18	Borehole	Not in use	Not equipped		None	Open
HBH24	-28.11683	26.70197	8.50		Borehole	In use	Submersible pump		Domestic & livestock	
HBH25	-28.11792	26.68013	24.20		Borehole	In use	Submersible pump		Domestic & livestock	
HBH26	-28.12714	26.65699	NAWL		Borehole	Not in use	Not equipped		None	Closed
HBH27	-28.12845	26.65437	1.40		Borehole	In use	Submersible pump		Domestic & livestock	
HBH28	-28.06977	26.66653	5.02	40	Borehole	In use	Submersible pump		Domestic	
HBH29	-28.07050	26.66551	NAWL		Borehole	In use	Mono pump		Livestock	
HBH30	-28.07475	26.67059	NAWL		Borehole	In use	Submersible pump		Livestock	
HBH31	-28.10189	26.64343	0.00		Borehole	In use	Not equipped		Domestic & garden	Artesian

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH32	-28.09055	26.65710	NAWL		Borehole	In use	Mono pump		Domestic & garden	
HBH33	-28.11279	26.63522	15.70		Borehole	In use	Submersible pump		Domestic & garden	
HBH34	-28.12682	26.69912	26.04	60	Borehole	In use	Submersible pump		Domestic & livestock	
HBH35	-28.11991	26.69965	3.70	20	Borehole	In use	Submersible pump		Domestic & garden	
HBH36	-28.06441	26.66184	2.66	18	Borehole	In use	Submersible pump		Domestic & garden	
HBH37	-28.06606	26.66227	3.18	20	Borehole	In use	Submersible pump		Domestic & garden	
HBH38	-28.18060	26.64045	2.94	50	Borehole	In use	Submersible pump		Livestock	
HBH39	-28.16963	26.63504	8.26	40	Borehole	In use	Submersible pump		Domestic & livestock	
HBH40	-28.16964	26.63456	8.75	16	Borehole	Not in use	Not equipped		None	Open
HBH41	-28.14747	26.72413	NAWL	80	Borehole	In use	Submersible pump		Domestic & irrigation	
HBH42	-28.14750	26.72416	NAWL	80	Borehole	In use	Submersible pump		Domestic & irrigation	
HBH43	-28.15102	26.72540	NAWL		Borehole	Not in use	Not equipped		None	No access
HBH44	-28.15038	26.72384	8.46	50	Borehole	In use	Submersible pump		Domestic & livestock	
HBH45	-28.15055	26.72382	8.40	50	Borehole	In use	Submersible pump		Domestic & livestock	
HBH46	-28.14817	26.72182	14.50		Borehole	In use	Submersible pump		Domestic & livestock	
HBH47	-28.14472	26.73037	NAWL		Borehole	In use	Solar pump		Domestic & livestock	

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH48	-28.17827	26.74558	11.03		Borehole	In use	Submersible pump		Domestic & livestock	
HBH49	-28.17886	26.74621	7.12		Borehole	In use	Submersible pump		Domestic & livestock	
HBH50	-28.18372	26.74679	NAWL		Borehole	In use	No access		Domestic & livestock	No access
HBH51	-28.19216	26.72884	NAWL		Borehole	In use	No access		Monitoring	No access
HBH52	-28.18767	26.73012	1.08	10	Borehole	In use	Not equipped		Monitoring	Open
HBH53	-28.18655	26.73110	2.80	5	Borehole	In use	Not equipped		Monitoring	Open
HBH54	-28.24539	26.71029	7.98		Borehole	In use	Submersible pump		Domestic & livestock	
HBH55	-28.24598	26.71291	NAWL		Borehole	In use	Submersible pump		Domestic & livestock	
HBH56	-28.21266	26.69929	1.79	30	Borehole	Not in use	Not equipped		None	Open
HBH57	-28.25142	26.74366	NAWL		Borehole	Not in use	Not equipped		None	Blocked
HBH58	-28.25125	26.74377	7.95		Borehole	In use	Submersible pump		Domestic & livestock	
HBH59	-28.25111	26.74382	8.35		Borehole	In use	Submersible pump		Domestic & irrigation	
HBH60	-28.24983	26.74353	12.90		Borehole	In use	Submersible pump		Domestic & irrigation	
HBH61	-28.24970	26.74315	12.55		Borehole	In use	Submersible pump		Domestic & irrigation	
HBH62	-28.22459	26.80767	12.70	30	Borehole	In use	Windpump		Livestock	
HBH63	-28.20166	26.78398	NAWL		Borehole	In use	Windpump		Livestock	

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH64	-28.21076	26.78479	NAWL		Borehole	No access	Windpump		No access	
HBH65	-28.21203	26.79141	NAWL		Borehole	No access	Windpump		No access	
HBH66	-28.21220	26.78951	NAWL		Borehole	No access	Windpump		No access	
HBH67	-28.21859	26.75478	NAWL		Borehole	Not in use	Not equipped		None	Open. Bees.
HBH68	-28.22435	26.75422	NAWL		Borehole	In use	Windpump		Domestic & livestock	
HBH69	-28.22273	26.75010	1.67		Borehole	In use	Submersible pump		Domestic & livestock	
HBH70	-28.22878	26.74097	3.10		Borehole	In use	Windpump		Domestic & livestock	
HBH71	-28.19508	26.74163	NAWL		Borehole	In use	Windpump		Domestic & livestock	
HBH72	-28.19312	26.73970	1.75		Borehole	Not in use	Not equipped		None	Open
HBH73	-28.19301	26.73964	1.63		Borehole	In use	Mono pump		Domestic & livestock	
HBH74	-28.22959	26.80025	NAWL		Borehole	In use	Windpump		Domestic & livestock	
HBH75	-28.23077	26.80533	NAWL		Borehole	In use	Windpump		Domestic & livestock	
HBH76	-28.09771	26.73687	NAWL		Borehole	Not in use	Handpump		None	
SRD	-28.12263	26.70925	N/A		Surface water	N/A	N/A		N/A	Sandrivier downstream point
SRU	-28.10651	26.73623	N/A		Surface water	N/A	N/A		N/A	Sandrivier upstream point
Notes:										

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
N/A: Not applicable										
NAWL: No access to water level										
****Contact details for relevant landowners have been recorded, however this information will be made available on request as it is protected by the Protection of Personal Information Act, 2013 (POPIA)**										

Table 27: Hydrocensus user survey: relevant information for geosites visited as part of the 2024 survey.

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH 161	-28.08858	26.73558	2.20		Borehole	In Use	Mono pump		Domestic	
HBH 159	-28.08745	26.73073	8.04		Borehole	In Use	Windpump		Domestic & livestock	
HBH 190	-28.07487	26.67060	3.36		Borehole	In Use	Submersible pump		Domestic	Automatic Float Switch / Pump 24/7 during planting season - Pivot
HBH 191	-28.07050	26.66555	4.11		Borehole	In Use	Submersible pump		Domestic	Pump 1 x pd for 7-5 h
HBH 186	-28.07994	26.66407	6.20		Borehole	In Use	Submersible pump		Irrigation	Automatic Float Switch / Pump 24/7 during planting season - Pivot
HBH 188	-28.07389	26.69870	3.69		Borehole	Not in Use	Not Equipped		None	Possible Collapsed

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH 187	-28.07589	26.71036	NAWL	5.85	Borehole	Not in Use	Submersible pump		None	
HBH 192	-28.07726	26.71039	6.19		Borehole	In Use	Windpump		Domestic	
HBH 185	-28.07550	26.71388	8.10	30	Borehole	In Use	Solar pump		Domestic	Solar pump.
HBH 193	-28.07540	26.71435	8.61	80	Borehole	Not in Use	Not Equipped		None	
HBH 199	-28.12519	26.64163	6.44		Borehole	In Use	Submersible pump		Domestic & livestock	Pump 1x pd for 3h - 25000 to 30000 L pd
HBH 180	-28.12453	26.64343	10.00	32.53	Borehole	Not in Use	Not Equipped		None	
HBH 181	-28.12470	26.64352	10.78	23.83	Borehole	Not in Use	Not Equipped		None	
BH 3 DDK	-28.16213	26.66035	32.61		Borehole	In Use	Windpump		Domestic & livestock	
HBH 194	-28.16296	26.65305	11.74		Borehole	In Use	Windpump		Livestock	
BH 1 DDK	-28.16716	26.66031	16.66		Borehole	In Use	Windpump		Livestock	

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
BH 2 KLPK	-28.17369	26.68213	5.51		Borehole	Not in Use	Not Equipped		None	
HBH 195	-28.17092	26.67996	3.86	38.15	Borehole	In Use	Submersible pump		Domestic & livestock	Pump 1x pd for 8h
HBH 196	-28.24546	26.71033	13.15	13.85	Borehole	Not in Use	Not Equipped		None	
HBH 197	-28.24557	26.71066	14.15	18	Borehole	In Use	Submersible pump		Domestic & livestock	Pump 1x pd for 3h
BH 2 BOS 278 0	-28.24598	26.71292	11.73	26	Borehole	In Use	Submersible pump		Domestic & irrigation	Current: Pump 1x pd for 8h Planting Season: Pump 24/7
BH 2 BOS 278 2	-28.22336	26.70576	5.22		Borehole	Not in Use	Windpump		None	Sibanye mine supply water to farmer
HBH 135	-28.22730	26.72159	42.13		Borehole	In Use	Submersible pump		Domestic & livestock	Pump 1x pd for 3h
HBH 137	-28.22991	26.73038	NAWL		Borehole	In Use	Windpump		Livestock	
HBH 136	-28.21125	26.73142	7.19		Borehole	In Use	Windpump		Livestock	
BH MOV	-28.24672	26.76825	6.78	37.3	Borehole	Not in Use	Not Equipped		None	

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH 149	-28.24129	26.77019	3.08	52.76	Borehole	Not in Use	Not Equipped		None	
BH 3 MVL	-28.24176	26.77052	6.78	31.8	Borehole	Not in Use	Not Equipped		None	
HBH 198	-28.11798	26.68012	19.40	49.18	Borehole	Not in Use	Not Equipped		None	
HBH 163	-28.20290	26.64291	12.21		Borehole	In Use	Submersible pump		Domestic & livestock	Current: Pump every 2nd day for livestock for 3h Planting Season: Pump 3 months per year 24/7 when planting - Pivot
HBH 200	-28.20139	26.65805	4.34		Borehole	In Use	Submersible pump		Irrigation	Current: Pump every 2nd day for livestock for 3h Planting Season: Pump 3 months per year 24/7 when planting - Pivot
HBH 1645	-28.22122	26.67334	6.84		Borehole	In Use	Submersible pump		Irrigation	Current: Pump every 2nd day for livestock for 3h Planting Season: Pump 3 months per year 24/7 when planting - Pivot
HBH 201	-28.16963	26.63507	8.96	30	Borehole	In Use	Submersible pump		Domestic & livestock	
HBH 178	-28.17027	26.60951	4.41		Borehole	In Use	Submersible pump		Domestic & livestock	

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH 166	-28.18181	26.76878	4.53	21.52	Borehole	Not in Use	Not Equipped		None	
BH 2 DDR	-28.18179	26.78140	5.39	34.1	Borehole	Not in Use	Not Equipped		None	
BH 2 DRR	-28.18186	26.78145	5.01	11.4	Borehole	Not in Use	Not Equipped		None	
BH 3 DRR	-28.18549	26.78080	5.52		Borehole	In Use	Windpump		Livestock	
BH 1 DRR	-28.19014	26.78088	8.20		Borehole	Not in Use	Windpump		None	
HBH 202	-28.18104	26.78060	13.31	44.39	Borehole	Not in Use	Not Equipped		None	
HBH 203	-28.27801	26.71489	18.13	60	Borehole	In Use	Submersible pump		Domestic & livestock	Pump 1X pd for 5h
HBH 204	-28.27730	26.71795	8.41		Borehole	In Use	Submersible pump		Domestic & livestock	Pump 1X pd for 5h
HBH 205	-28.31111	26.74324	NAWL		Borehole	In Use	Submersible pump		Livestock	
HBH 114	-28.30193	26.74312	NAWL		Borehole	Not in Use	Windpump		None	

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH 125	-28.26804	26.67350	5.15		Borehole	In Use	Windpump		Livestock	
HBH 123	-28.27317	26.69540	4.69	38	Borehole	In Use	Submersible pump		Irrigation	Planting Season: Pump 1X pd for 12h - Have 2 pump in
HBH 124	-28.27297	26.69471	4.60	35	Borehole	Not in Use	Submersible pump		None	
HBH 130	-28.27903	26.69258	5.89		Borehole	In Use	Submersible pump		Irrigation	Planting Season: Pump 1X pd for 12h - Use as back up pump
HBH 129	-28.27726	26.68714	5.56	18.28	Borehole	In Use	Submersible pump		Irrigation	Planting Season: Pump 1X pd for 12H
HBH 128	-28.26253	26.69294	5.50		Borehole	In Use	Windpump		Irrigation	
HBH 127	-28.25532	26.67986	7.34		Borehole	Not in Use	Windpump		None	
HBH 119	-28.26786	26.70028	5.14		Borehole	In Use	Windpump		Livestock	
HBH 120	-28.26775	26.70218	13.85		Borehole	In Use	Submersible pump		Domestic	
HBH 118	-28.26952	26.70053	5.37		Borehole	In Use	Windpump		Livestock	

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH 122	-28.26731	26.70009	6.06		Borehole	In Use	Submersible pump		Domestic & livestock	
HBH 116	-28.23821	26.71827	4.70		Borehole	Not in Use	Windpump		None	
HBH 117	-28.24192	26.73159	3.21		Borehole	In Use	Windpump		Livestock	
HBH 151	-28.25538	26.75884	6.98	44.25	Borehole	Not in Use	Not Equipped		None	
BH GLR	-28.13207	26.77029	11.58	30	Borehole	In Use	Submersible pump		Domestic	Pump 1X per week for 5H
BH 1 GLR	-28.13375	26.79048	6.55		Borehole	In Use	Submersible pump		Domestic & livestock	Pump 1X pd for 8H
HBH 168	-28.13460	26.77929	4.95	48	Borehole	In Use	Submersible pump		Domestic & livestock	Pump 1X pd for 4H
HBH 206	-28.13106	26.75650	15.20		Borehole	In Use	Submersible pump		Domestic & livestock	Pump 1X pd for 6H
HBH 207	-28.12670	26.75457	25.20		Borehole	In Use	Submersible pump		Domestic	Automatic Float Switch
HBH 208	-28.13339	26.76155	14.93	24.28	Borehole	Not in Use	Not Equipped		None	

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
HBH 209	-28.13201	26.76096	11.65	35	Borehole	In Use	Submersible pump		Domestic & livestock	
HBH 210	-28.13407	26.75744	15.89	20.99	Borehole	Not in Use	Not Equipped		None	
HBH 211	-28.13360	26.75759	15.87	45	Borehole	In Use	Submersible pump		Domestic & livestock	Pump 3X per week for 4H
HBH 212	-28.12873	26.80519	9.46		Borehole	In Use	Windpump		Livestock	
BH 2 HAK	-28.13681	26.80747	6.45	24.25	Borehole	Not in Use	Not Equipped		None	
HBH 138	-28.15011	26.76916	8.86		Borehole	In Use	Windpump		Livestock	
HBH 167	-28.12028	26.80224	24.33		Borehole	Not in Use	Submersible pump		None	
HBH 213	-28.21268	26.69928	3.87	30.03	Borehole	Not in Use	Not Equipped		None	
HBH 214	-28.21028	26.60866	9.54	30	Borehole	In Use	Submersible pump		Domestic	Pump every second day for 2H
12A	-28.27250	26.74197	9.89		Borehole	In use	Equipped		Domestic & livestock	Robert have previous sample data

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
BH04	-28.11950	26.72231			Borehole	In use	Equipped		Domestic & livestock	Borehole also utilised for monitoring purposes
BH17C	-28.14753	26.71414	12.24	60	Borehole	In use	Equipped		Livestock	Borehole also utilised for monitoring purposes
AVO1	-28.09539	26.73217			Borehole	In use	Equipped		Domestic	This site was drilled by Tetra4 for use by the local community. Borehole also utilised for monitoring purposes.
BR26B	-28.10730	26.70517			Borehole	In use	Not Equipped		Monitoring	
7A	-28.15336	26.71242			Borehole	In use	Equipped		Domestic	Water is used for domestic purposes by the nearby community. Borehole also utilised for monitoring purposes
7B	-28.14756	26.72417	12.12		Borehole	In use	Equipped		Domestic	Borehole also utilised for monitoring purposes
11A	-28.19314	26.73970			Borehole	In use	Equipped		Livestock	Borehole also utilised for monitoring purposes
11B	-28.19206	26.74042			Borehole	In use	Equipped		Domestic	Borehole also utilised for monitoring purposes
OB	-28.22934	26.75741			Borehole	In use	Not Equipped		Monitoring	

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
15D	-28.27739	26.64169	5.71		Borehole	In use	Equipped		Livestock	Borehole also utilised for monitoring purposes
15C	-28.27614	26.64281			Borehole	In use	Equipped		Domestic	Water is used by the nearby community for domestic purposes. Borehole also utilised for monitoring purposes
15A	-28.27368	26.64421			Borehole	In use	Equipped		Domestic	Borehole also utilised for monitoring purposes
25A	-28.28703	26.74206			Borehole	In use	Equipped		Domestic & livestock	Borehole also utilised for monitoring purposes
Kal2_1	-28.17840	26.74535	7.70		Borehole	In use	Equipped		Domestic & livestock	Borehole also utilised for monitoring purposes
BH01	-28.12723	26.71919			Borehole	In use	Not Equipped		Monitoring	Borehole also utilised for monitoring purposes
MON MVDRE1	-28.12801	26.72016			Borehole	In use	Not Equipped		Monitoring	
16B	-28.14819	26.72186	13.89		Borehole	In use	Equipped		Irrigation	Borehole also utilised for monitoring purposes
24A	-28.15353	26.73250	8.00		Borehole	In use	Equipped		Domestic	Borehole also utilised for monitoring purposes

Site ID	Latitude	Longitude	Water level (mbgl)	Borehole depth (mbgl)	Site type	Site status	Equipment	Property Owner**	Water application	Field notes
24B	-28.15169	26.73694			Borehole	In use	Equipped		Livestock	Borehole also utilised for monitoring purposes
8A			7.45		Borehole	In use	Equipped		Livestock	Borehole also utilised for monitoring purposes
BH8	-28.11837	26.72098			Borehole	In use	Equipped		Domestic	Borehole also utilised for monitoring purposes

Notes:

N/A: Not applicable

NAWL: No access to water level

**** Contact details for relevant landowners have been recorded, however this information will be made available on request as it is protected by the Protection of Personal Information Act, 2013 (POPIA)**

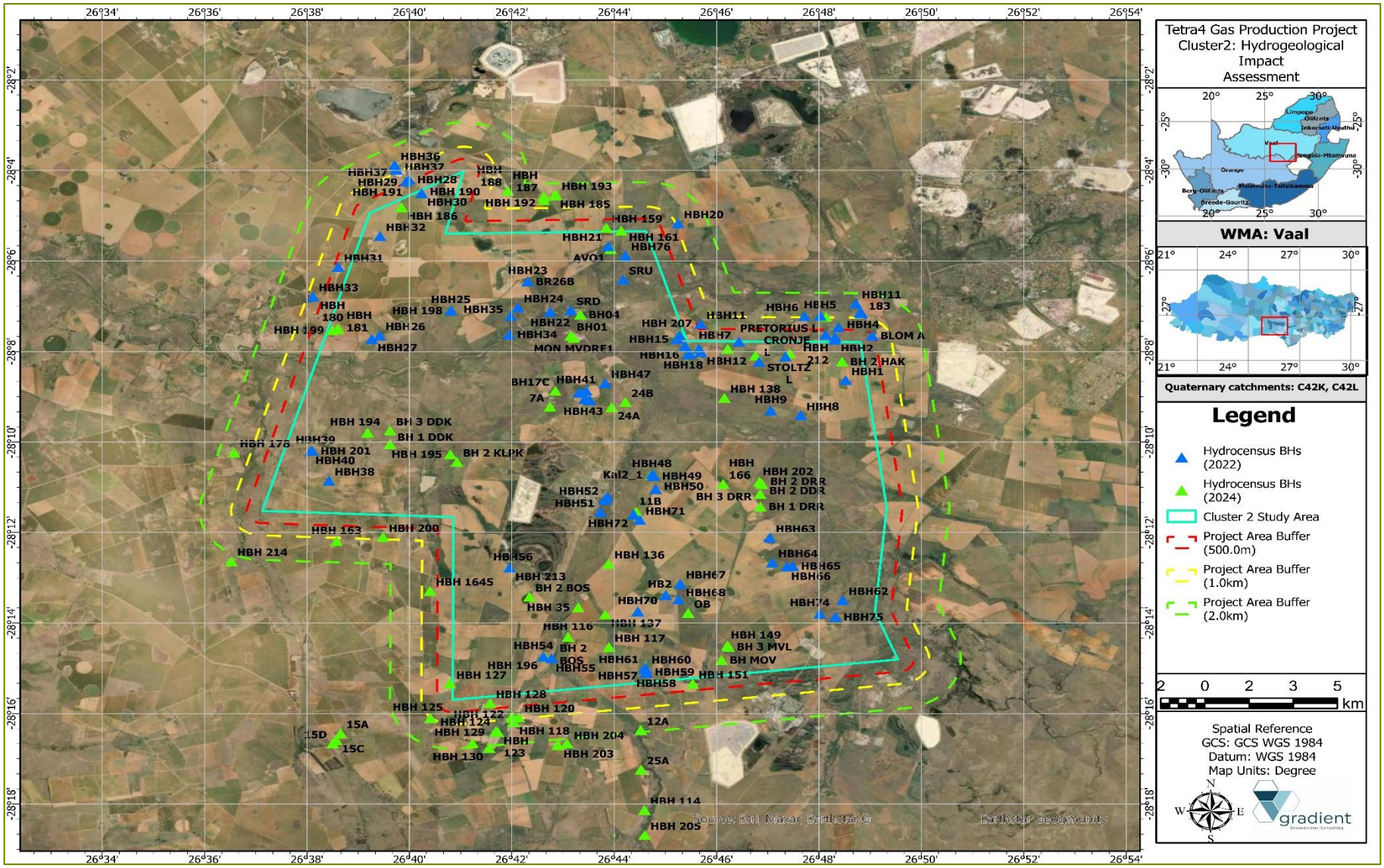


Figure 30: Spatial distribution map of the geosites visited as part of the 2022 and 2024 hydrocensus user surveys.

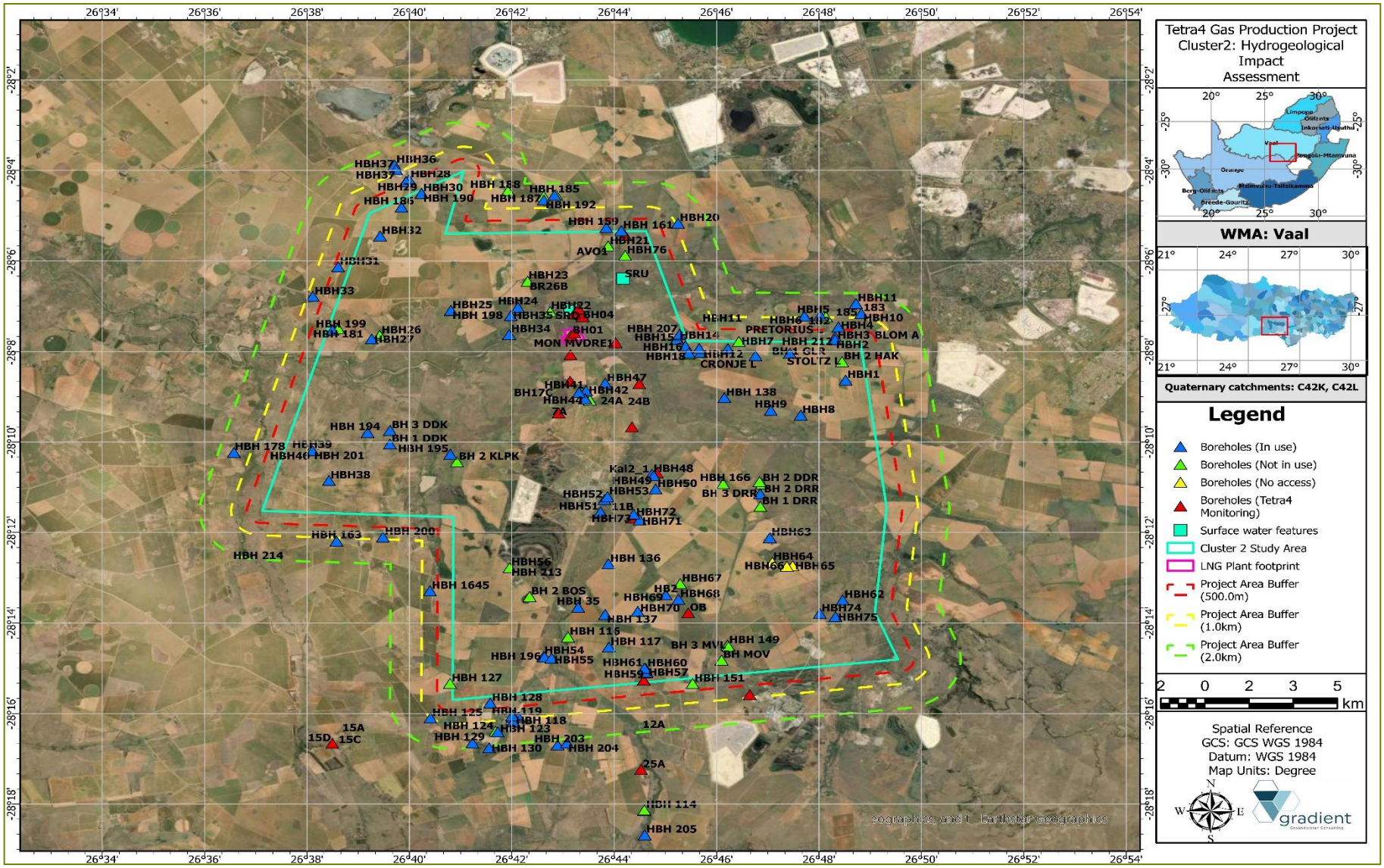


Figure 31: Spatial distribution map of the groundwater status and application.

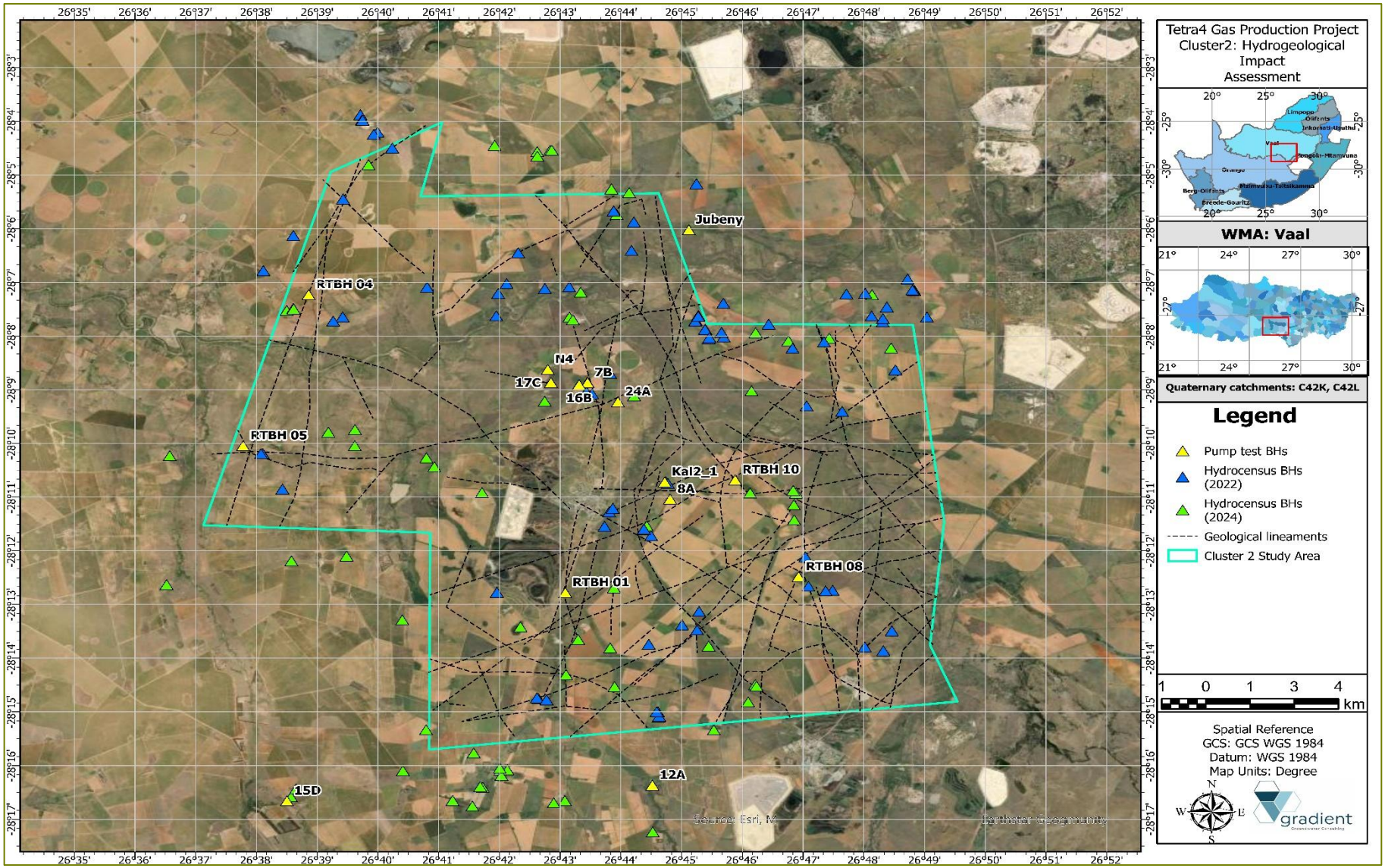


Figure 32: Map indicating boreholes subjected to constant discharge aquifer tests in relation to existing hydrocensus geosites.

8.1.4.2 GROUNDWATER-SURFACE WATER INTERACTION

Groundwater and surface water interaction is an essential component of the hydrological cycle. The hyporheic zone (stream bed) is the zone of most interaction (Adams et. al.,2012). According to records documented by Van Tonder and Dennis (2003), under natural conditions this area exhibits certain regions where there is pronounced interaction between surface and groundwater. The two regimes are therefore well-linked and should be integrated to manage any water-related issues in these catchments. Regional drainages can be generally classified as influent or gaining stream systems as the groundwater head elevation of the water table in the vicinity of the stream is higher than the altitude of the stream bed and, accordingly, there definitely exists groundwater discharge as baseflow to local drainages. The alluvial associated with the floodplains of the Sand - and Doringrivier forms a primary aquifer and is directly connected with surface water resources, especially during high flow conditions (Lea, 2017).

8.1.4.3 GROUNDWATER QUALITY

The proposed seismic vibroseis activities are expected to have very low to negligible impacts on groundwater quality. The groundwater quality information presented here is therefore a high-level summary from specialist assessments undertaken during the Phase 2 EIA and is provided primarily as baseline context to inform this assessment.

This section provides a brief discussion on the available groundwater and surface water quality information for the study area, based on hydrocensus, monitoring and site characterisation sampling. Overall, ambient groundwater quality is generally good to moderate, with groundwater described as neutral, saline to very saline and hard to very hard, largely reflecting the local geology deposited in shallow marine environments (Lea, 2017). Elevated nitrate (NO_3) concentrations are observed in many boreholes and are likely associated with agricultural land use (fertiliser leachate), with higher concentrations generally occurring within or down-gradient of planted crop areas and near surface water features. Total dissolved solids (TDS) increase towards the northern portion of the study area and near drainages. Isolated localities indicate elevated Ca, Mg, Na and Cl, potentially reflecting abstraction-related effects and/or more stagnant groundwater being sourced from the fractured aquifer matrix.

Surface water was sampled upstream and downstream of the Sandrivier, down-gradient of the existing and proposed plant expansion footprint. Results indicate moderate to good surface water quality, with Al and Fe slightly elevated; no material downstream deterioration is indicated relative to the upstream sample, although elevated Al and Fe are noted in the analysed surface water samples. Screening for gross alpha and gross beta activity indicates that groundwater radioactivity is generally within World Health Organisation (WHO) guideline limits for most boreholes.

8.1.5 SURFACE WATER AND DRAINAGE

The greater study is situated in primary catchment (C) of the Vaal River drainage system which covers a total area of approximately 246 674.5 km2. The resource management falls under the Vaal Water Management Area (WMA5) which spans portions of the North West Province, northern Free State as well northern sections of the Northern Cape. An overview of the study area with respect to the quaternary catchments and wetland areas is included in Figure 29. The application area is situated within quaternary catchments C42K (nett surface area of 68 km2) and C42L (nett surface area of 510.8 km2), falls within hydrological zone E and has an estimated mean annual runoff (MAR) of between 10 to 13 mcm (million cubic metres) (WR 2012). The hydrology of the region is characterised by predominately perennial watercourses with the regional drainage occurring in a general west to north-western direction via the Sandrivier and Doornrivier both of which are traversing the study area from east to west (Sandrivier) and southeast to northwest (Doornrivier). A non-perennial drainage, Bosluisspruit, also traverses the study area and generally drains the catchment in a northern direction. The Doornrivier converges with the Sandrivier approximately 1.3 km to the northeast of the study area from where it flows in a general westerly direction before joining the Vetrivier roughly ~ 30 km downstream of the application area. Major surface water features being fed by the drainage system(s) of this quaternary catchment include the Bloemhof Dam situated <100 km to the northwest.

8.1.6 AIR QUALITY

An air quality study has been undertaken by Airshed Planning Professionals as part of the Cluster 2 EIA. The air quality findings are presented in the subsections below.

8.1.6.1 **SURFACE WIND FIELD**

The wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the yellow area, for example, representing winds in between 4 and 5 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s are also indicated. The period wind field and diurnal variability in the wind field are shown in Figure 33, while the seasonal variations are shown in Figure 34.

During the 2019 to 2021 period, the wind field was dominated by winds from the north-northeast and northeast, followed by northerly and easterly winds. During the day (6AM – 6PM), the prevailing wind field is from the north to northeast and the west, with less frequent winds from the north-westerly sector, the easterly sector and the south-west. During the night, the wind field shifts to the easterly sector (north-northeast to east-southeast), with very little flow from the westerly sector. Long-term air quality impacts are therefore expected to be the most significant to the south and southwest of the application area. The strongest winds (more than 6 m/s) were also from the north and northeast and occurred mostly during the day, with 15 m/s the highest wind speed recorded. The average wind speed over the three years is 3.7 m/s, with calm conditions occurring for 3.5% of the time (Figure 33).

Seasonally, the wind flow pattern conforms to the period average wind flow pattern. The seasonal wind field shows little seasonal differences in the wind fields. During summer and spring, the dominant winds are from the north-northeast to east, with more frequent westerly winds during spring. Autumn reflects dominant north-easterly and easterly winds, with a similar wind field during winter, but with more frequent north-north-easterly and east-south-easterly winds (Figure 34).

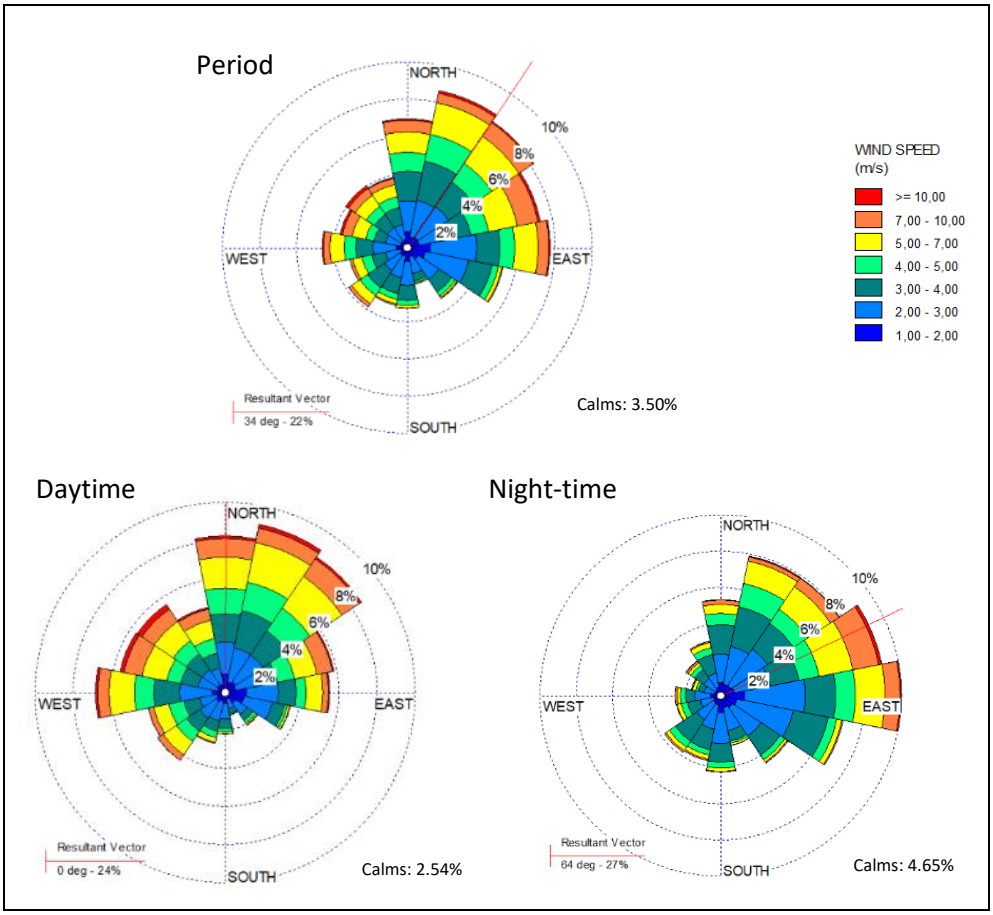


Figure 33: Period, day- and night-time wind roses (SAWS Welkom Data, 2019 to 2021).

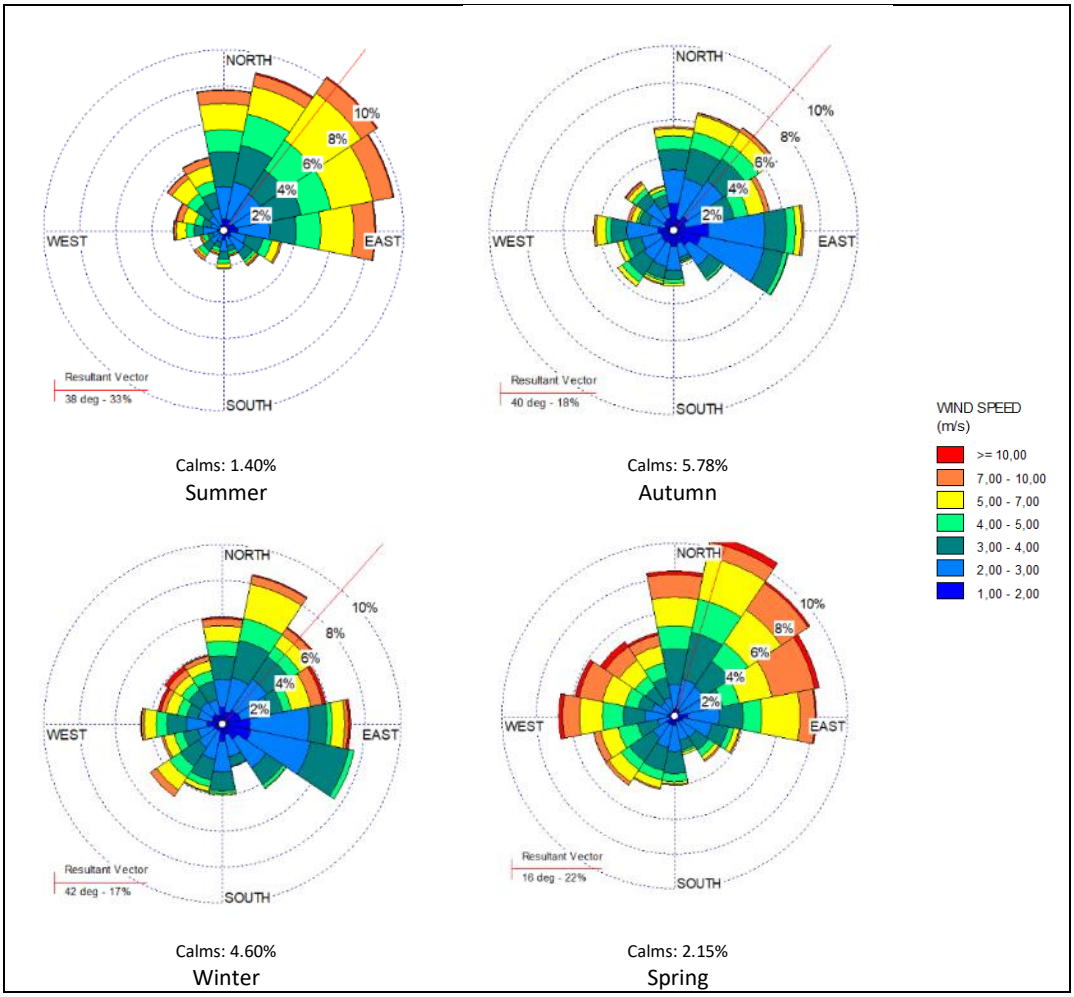


Figure 34: Seasonal wind roses (SAWS Welkom Data, 2019 to 2021).

8.1.6.2 **AMBIENT AIR QUALITY WITHIN THE REGION**

8.1.6.2.1 SOURCES OF POLLUTION IN THE REGION

Neighbouring land-use in the surrounding of the proposed project comprises predominantly of agriculture activities. These land-uses contribute to baseline pollutant concentrations via fugitive and process emissions, vehicle tailpipe emissions, household fuel combustion, biomass burning and windblown dust from exposed areas.

Agriculture

Agriculture is a major land-use activity within and beyond the Project boundary. These activities include crop farming such as maize, and livestock farming. Particulate matter is the main pollutant of concern from agricultural activities as particulate emissions are derived from windblown dust, burning crop residue, and dust entrainment because of vehicles travelling along dirt roads. In addition, pollen grains, mould spores and plant and insect parts from agricultural activities all contribute to the particulate load. Should chemicals be used for crop spraying, they would typically result in odiferous emissions. Crop residue burning is also an additional source of particulate emissions and other toxins. Due to the small scale of farming activities these are regarded to have an insignificant cumulative impact.

Livestock farms, especially cattle, are also significant sources of fugitive dust especially when feedlots are used and the cattle trample in confined areas. Pollutants associated with dairy production for instance include ammonia (NH3), hydrogen sulphides (H_2S), methane (CH_4), carbon dioxide (CO_2), oxides of nitrogen (NO_x) and

odour related trace gasses. According to the US-EPA, cattle emit methane through a digestive process that is unique to ruminant animals called enteric fermentation. The calf-cow sector of the beef industry was found to be the largest emitter of methane emissions. Where animals are densely confined the main pollutants of concern include dust from the animal movements, their feed and their manure, ammonia (NH_3) from the animal urine and manure, and hydrogen sulphides (H_2S) from manure pits.

Organic dust includes dandruff, dried manure, urine, feed, mould, fungi, bacteria and endotoxins (produced by bacteria, and viruses). Inorganic dust is composed of numerous aerosols from building, materials and the environment. Since the dust is biological it may react with the defence system of the respiratory tract. Odours and VOCs associated with animal manure is also a concern when cattle are kept in feedlots. The main impact from methane is on the dietary energy due to the reduction of carbon from the rumen. Dust and gasses levels are higher in winter or whenever animals are fed, handled or moved.

Mining Sources

Particulates represent the main pollutant of concern at mining operations. The amount of dust emitted by these activities depends on the physical characteristics of the material, the way in which the material is handled and the weather conditions (e.g. high wind speeds, rainfall, etc.). Mining of gold, as well as ore extraction and processing plants are all commercial activities situated in the region of the Project.

Domestic Fuel Combustion

Domestic households are known to have the potential to be one the most significant sources that contribute to poor air quality within residential areas. Individual households are low volume emitters, but their cumulative impact is significant. It is likely that households within the local communities or settlements utilize coal, paraffin and/or wood for cooking and/or space heating (mainly during winter) purposes. Pollutants arising from the combustion of wood include respirable particulates, CO and SO_2 with trace amounts of polycyclic aromatic hydrocarbons (PAHs), in particular benzo(a)pyrene and formaldehyde. Particulate emissions from wood burning have been found to contain about 50 % elemental carbon and about 50 % condensed hydrocarbons.

Coal is relatively inexpensive in the region and is easily accessible due to the proximity of the region to coal mines and the well-developed coal merchant industry. Coal burning emits a large amount of gaseous and particulate pollutants including SO_2, heavy metals, PM including heavy metals and inorganic ash, CO, PAHs (recognized carcinogens), NO_2 and various toxins. The main pollutants emitted from the combustion of paraffin are NO_2, particulates, CO and PAHs.

Biomass Burning

Biomass burning includes the burning of evergreen and deciduous forests, woodlands, grasslands, and agricultural lands. Within the project vicinity, crop-residue burning and wildfires (locally known as veld fires) may represent significant sources of combustion-related emissions. The frequency of wildfires in the grasslands varies between annual and triennial.

Biomass burning is an incomplete combustion process (Cachier, 1992), with carbon monoxide, methane and nitrogen dioxide gases being emitted. Approximately 40 % of the nitrogen in biomass is emitted as nitrogen, 10% is left in the ashes, and it may be assumed that 20 % of the nitrogen is emitted as higher molecular weight nitrogen compounds (Held, et al., 1996). The visibility of the smoke plumes is attributed to the aerosol (particulate matter) content. In addition to the impact of biomass burning within the vicinity of the Project activity, long-range transported emissions from this source can be expected to impact on the air quality between the months of August to October. It is impossible to control this source of atmospheric pollution loading; however, it should be noted as part of the background or baseline condition before considering the impacts of other local sources.

Fugitive Dust Sources

These sources are termed fugitive because they are not discharged to the atmosphere in a confined flow stream. Sources of fugitive dust identified in the study area include paved and unpaved roads and wind erosion of sparsely vegetated surfaces.

Unpaved and paved roads

Emissions from unpaved roads constitute a major source of emissions to the atmosphere in the South African context. When a vehicle travels on an unpaved road the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong turbulent air shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Dust emissions from unpaved roads vary in relation to the vehicle traffic and the silt loading on the roads. Unpaved roads in the region are mainly haul and access roads.

Emissions from paved roads are significantly less than those originating from unpaved roads, however they do contribute to the particulate load of the atmosphere. Particulate emissions occur whenever vehicles travel over a paved surface. The fugitive dust emissions are due to the re-suspension of loose material on the road surface. Paved roads in the region include the R710, M4, R708 and R30.

Wind erosion of open areas

Windblown dust generates from natural and anthropogenic sources. For wind erosion to occur, the wind speed needs to exceed a certain threshold, called the threshold velocity. This relates to gravity and the inter-particle cohesion that resists removal. Surface properties such as soil texture, soil moisture and vegetation cover influence the removal potential. Conversely, the friction velocity or wind shear at the surface is related to atmospheric flow conditions and surface aerodynamic properties. Thus, for particles to become airborne, its erosion potential has to be restored; that is, the wind shear at the surface must exceed the gravitational and cohesive forces acting upon them, called the threshold friction velocity. Every time a surface is disturbed, its erosion potential is restored (US EPA, 2004). Erodible surfaces may occur as a result of agriculture and/or grazing activities.

Vehicle Tailpipe Emissions

Emissions resulting from motor vehicles can be grouped into primary and secondary pollutants. While primary pollutants are emitted directly into the atmosphere, secondary pollutants form in the atmosphere as a result of chemical reactions. Significant primary pollutants emitted combustion engines include carbon dioxide (CO_2), carbon (C), sulfur dioxide (SO_2), oxides of nitrogen (mainly NO), particulates and lead. Secondary pollutants include NO_2, photochemical oxidants such as ozone, sulfur acid, sulphates, nitric acid, and nitrate aerosols (particulate matter). Vehicle type (i.e. model-year, fuel delivery system), fuel (i.e. oxygen content), operating (i.e. vehicle speed, load) and environmental parameters (i.e. altitude, humidity) influence vehicle emission rates.

Transport in the vicinity of the Project is via trucks and private vehicles along the R710, M4, R708 and R30 roads (which are the main sources of vehicle tailpipe emissions), as well as vehicles and machinery travelling on unpaved and private roads.

8.1.7 NOISE BASELINE

A specialist assessment of the noise environment within the study area has been undertaken by Airshed Planning Professionals as part of the Tetra4 Cluster 2 Virginia Gas Production EIA (2024/2025). Although the currently proposed project activities are anticipated to have minimal impact, the 2024/2025 report serves to establish the noise baseline for the Cluster 2 Area. The findings are presented in the subsections below.

8.1.8 NOISE SENSITIVE RECEPTORS

NSRs generally include places of residence and areas where members of the public may be affected by noise generated by proposed activities. Potential noise sensitive receptors within the study area are shown in Figure 35 include individual homesteads and industrial and residential areas (i.e., Virginia).

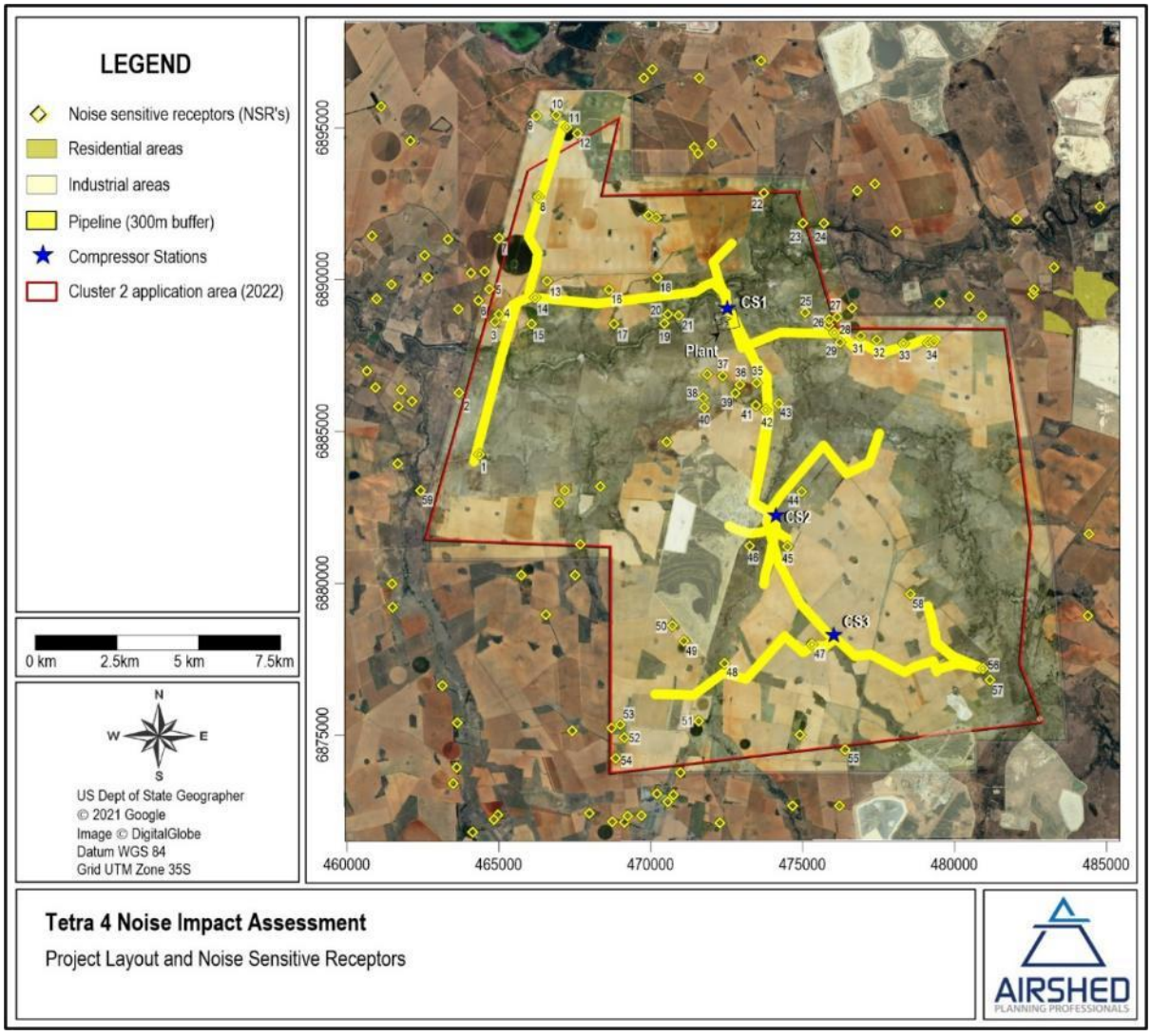


Figure 35: Sensitive noise receptors within the study area.

Sampling points for the noise survey conducted by Airshed in 2022 were selected based on proposed production activites (Tetra4 Cluster 2 Production Right EIA, 2025), position of identified sensitive receptors and noise survey locations selected for the baseline campaign conducted in 2016. The baseline 2016 and 2022 noise survey results are included in the specialist report. All the measurements indicated a site with a very complex sound character. Areas away from busy roads and mining activities are very quiet, with measurement locations closer to houses, busy roads and mining activities indicating higher sound levels. Vegetation growth closer to dwellings creates habitat, attracting birds and insects, which in turn make sounds that increases the ambient sound levels. The vegetation also increased wind-induced noises. The larger study area, away from roads, dwellings and mining activities can be rated as Rural as per the SANS 10103:2008 criteria.

8.1.9 TOPOGRAPHY

The topography within the Cluster 2 Boundary is characterized by the gently undulating plains, as can be seen in Figure 36 typical of the Highveld region in the Free State, situated south of Welkom. The elevation across the study area generally ranges from approximately 1,280m to 1,420m above sea level. The highest terrain is located in the southern and south-eastern sections where the contour lines indicate a gradual rise toward localized ridges. Conversely, the lowest elevations are found along the primary river basins in the northern and western reaches of the site.

The landscape is significantly defined by its hydrological features, most notably the Sand River, which meanders from east to west through the northern third of the demarcated area. The terrain slopes steadily toward this

river, which is fed by several smaller NFEPA-listed tributaries and drainage lines that dissect the central and southern portions of the polygon. These watercourses have carved shallow valleys into the landscape, creating a series of minor ridgelines that influence the local drainage patterns toward the north.

In terms of surface character, it is predominantly a low gradient across the central plains, making the area highly suitable for the existing agricultural activities. This relatively level and stable terrain is favourable for the deployment of vibroseis trucks, as the existing network of secondary roads and farm tracks provides manageable access across the natural contours of the study area.

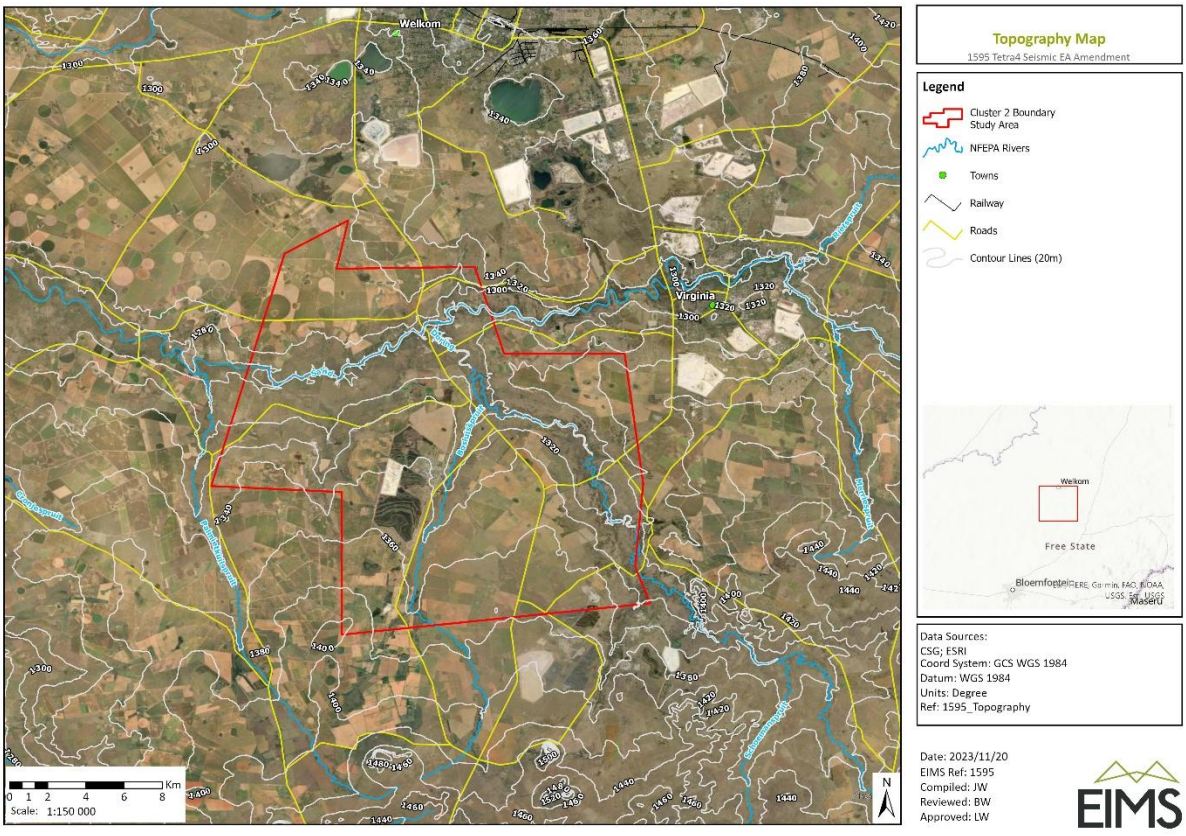


Figure 36: Topography map of project area.

8.1.10 LANDSCAPE QUALITY AND VISUAL

Landscape and visual impacts are being assessed by Environmental Planning and Design and the specialist assessment was undertaken as part of the Cluster 2 Production EIA (2024/2025). The baseline receiving environment findings are presented in the subsections below.

8.1.10.1 **LANDSCAPE CHARACTER AREAS AND VISUAL ABSORPTION CAPACITY (VAC)**

Landscape Character Areas (LCAs) are defined as “single unique areas which are the discrete geographical areas of a particular landscape type”. The overriding character differentiating factors within the subject landscape appear to be landform /drainage and vegetation cover. The landform appears to divide the landscape into Four discrete areas including;

1. Cultivated Rural Landscape Character Area. This area has gently undulating topography and a predominance of cultivated fields that are generally separated by areas of natural grassland. This is a relatively open landscape with little VAC which is only provided by minor ridgelines and alien vegetation;
2. Natural Landscape Character Area. This area is comprised of the shallow valleys surrounding watercourses and is generally covered in Natural Vegetation including grassland and woody alien

species that occur in alluvial areas. VAC within these areas is generally moderate due to the fact that much of the woody vegetation extends above eye level;

3. Mining Landscape Character Area. This area includes all mining operations and the extensive stockpiles and infrastructure that associated with them; and
4. The Urban / Residential LCA. This area is comprised entirely of the urban areas of Virginia and Welkom. VAC is generally high within these areas due to the extent of structures and urban vegetation. Also due to distance (minimum 2.7km) surrounding rural vegetation and mining activities are likely to provide an effective screen.

Visual Receptors are defined as "individuals and / or defined groups of people who have the potential to be affected by the proposal". The significance of a change in a view for a visual receptor is likely to relate to use. Uses such as guest houses, recreation and tourism related areas are likely to rely on the maintenance of an outlook for successfully attracting guests and users. Residential areas could depend on outlook for the enjoyment of the area by residents and for maintaining property values. A route that is particularly important for tourism may also be dependent on outlook for the maintenance of a suitable experience for users.

Visual receptors within the affected landscape that due to use could be sensitive to landscape change are indicated below.

- Area Receptors may include;
    - Urban areas within the towns of Virginia and Welkom which are located approximately 2.7km to the east and 7.3km north of the proposed Cluster 2 Boundary Extension respectively; and
    - The H Joel Private Nature Reserve which, at its closest, is located approximately 1.0km to the south of the proposed Cluster 2 Extension area.
- Point Receptors that include;
    - There are a number of Local Farmsteads and Homesteads located both within the surrounding landscape. From the site visit it appears that the farmsteads within the proposed site have a primarily agricultural use.
- Linear Receptors or routes through the area that include;
    - The R30, the R730 and the unsurfaced local roads that that run through the proposed Cluster 2 Extension area. All of these are used mainly by local people with little or no tourism / recreational importance.

The landscape character areas and visual receptors within the study area are presented in Figure 37..

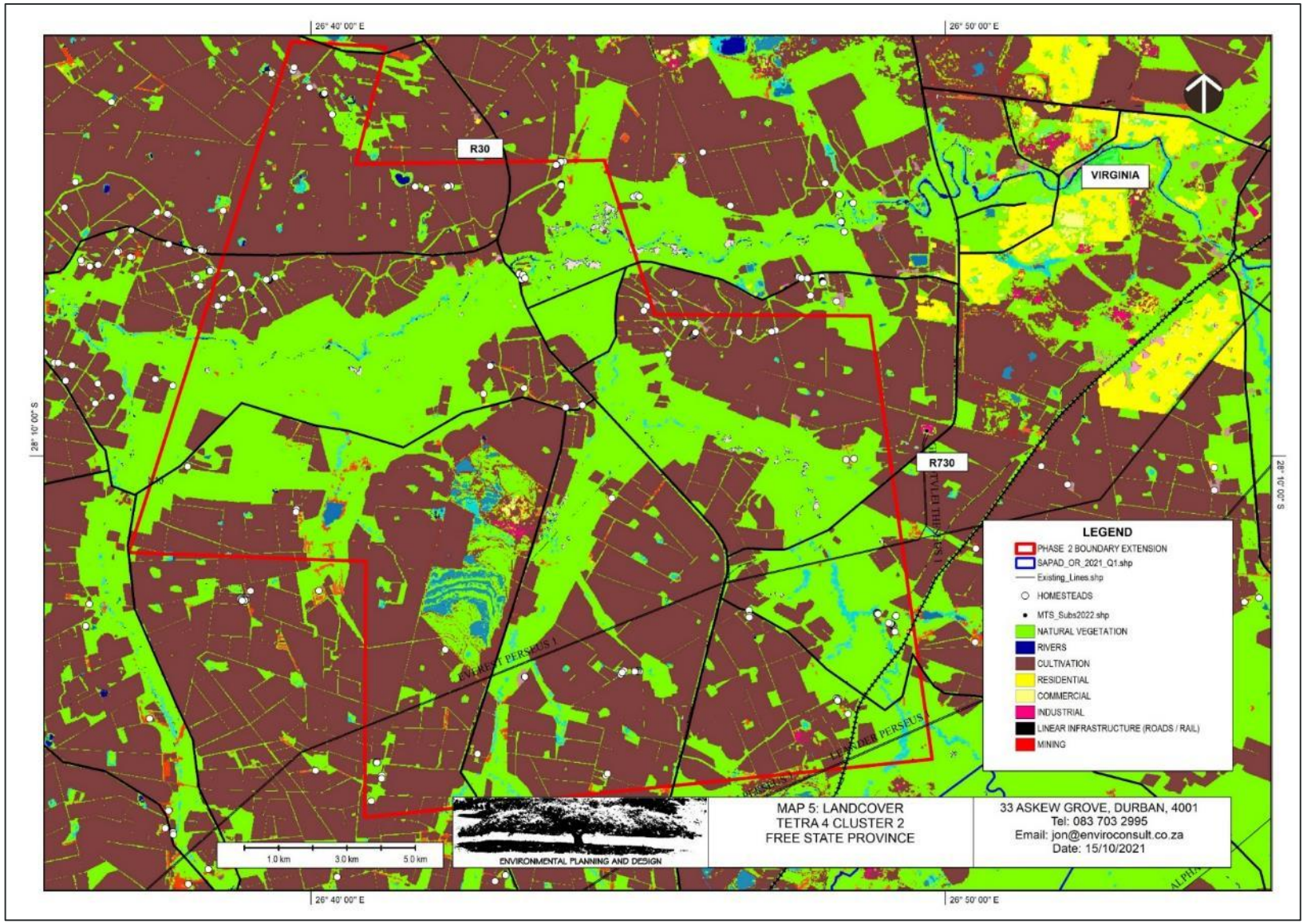


Figure 37: Landscape character areas and visual receptors.

8.1.10.2 **VISUAL SENSITIVITY**

Site (Landscape) sensitivity (Figure 38) is largely related to the way that the site fits into the surrounding landscape i.e. is it an important component. The sensitivity of potential receptors generally relates to whether views are important to support current or potential usage. However, they also relate to nuisance and whether for instance a proposed use could impose on and make an existing use uncomfortable or even untenable.

The landscape within which the proposed projects is located is not highly sensitive. It has largely been transformed by large scale mining operations and commercial agriculture. The topography and vegetation patterns are also such that there is little VAC, receptors are therefore to a large degree affected by views of mining operations. However, the development proposal is likely to result in a finer grain industrial character which could mean that even though most individual elements are relatively small they will be considerably closer to most potential receptors. The visual sensitivity of the landscape has been categorised into no-go, high, medium and low (non-sensitive) areas as described below.

- No-Go Areas:
    - Since the affected landscape is highly transformed by both agriculture and mining and because protected areas are highly unlikely to be affected, there are no potentially affected areas where development should not happen due to potential landscape or visual impacts.
- Areas with High Sensitivity:
    - There are potentially affected areas that could be sensitive to potential development, these include:
        - All Natural areas that are largely located within the shallow river valleys. These areas have largely survived in a natural state due to their unsuitability for large scale mining and agriculture, they are therefore relatively intact. In addition to the provision of key environmental services such as attenuation of storm run-off, they provide visual buffers between intensive agriculture and mining operations. There are therefore sound reasons to maintain the integrity of these areas. From a landscape and visual perspective however, it is likely that the location of wells, compressor stations and pipelines might occur within these areas with minimal impact. However, this is subject to minimal disturbance and appropriate mitigation to ensure that the natural landscape character remains intact;
        - All areas within close proximity to homesteads. Currently there are views from many homesteads of large-scale mining operations. However, there are very few homesteads that have close range views over industrial operations. It is possible that the development of the various elements associated with the proposed project could be located in close proximity to homesteads and, subject to distance, these could dominate views of residents. Due to the small scale of the majority of proposed elements, the screening ability of natural areas in which many of the proposed elements are located, a 250 m buffer has been indicated around homesteads. It is not proposed that development in these areas is prevented, however, development must be undertaken in a way that views from affected homesteads are not dominated by views of the elements, appropriate mitigation is undertaken, and appropriate consultation is undertaken with residents.
        - All areas within close proximity to roads. Views from the main “R” roads that pass through the affected area are currently largely comprised of large-scale arable agriculture in the foreground and middle distance backed by large scale mining operations. These views are punctuated by natural landscape areas as the motorist crosses the shallow river valleys. Subject to distance, the majority of proposed elements are such that their location within the current large scale open agricultural

landscape is unlikely to be highly obvious. Due to their scale, a well, compressor station or LV overhead power line located 250 m away from a road is unlikely to the highly visible from the road. A pipeline at any distance from the road, as long as appropriate rehabilitation is undertaken, is unlikely to be highly visible.

- Areas with Medium Sensitivity
    - Areas with medium sensitivity to development include all arable agricultural areas outside 250 m from homesteads and roads.
- Non-Sensitive Areas
    - All non-sensitive areas including mining areas outside 250m from homesteads and roads.

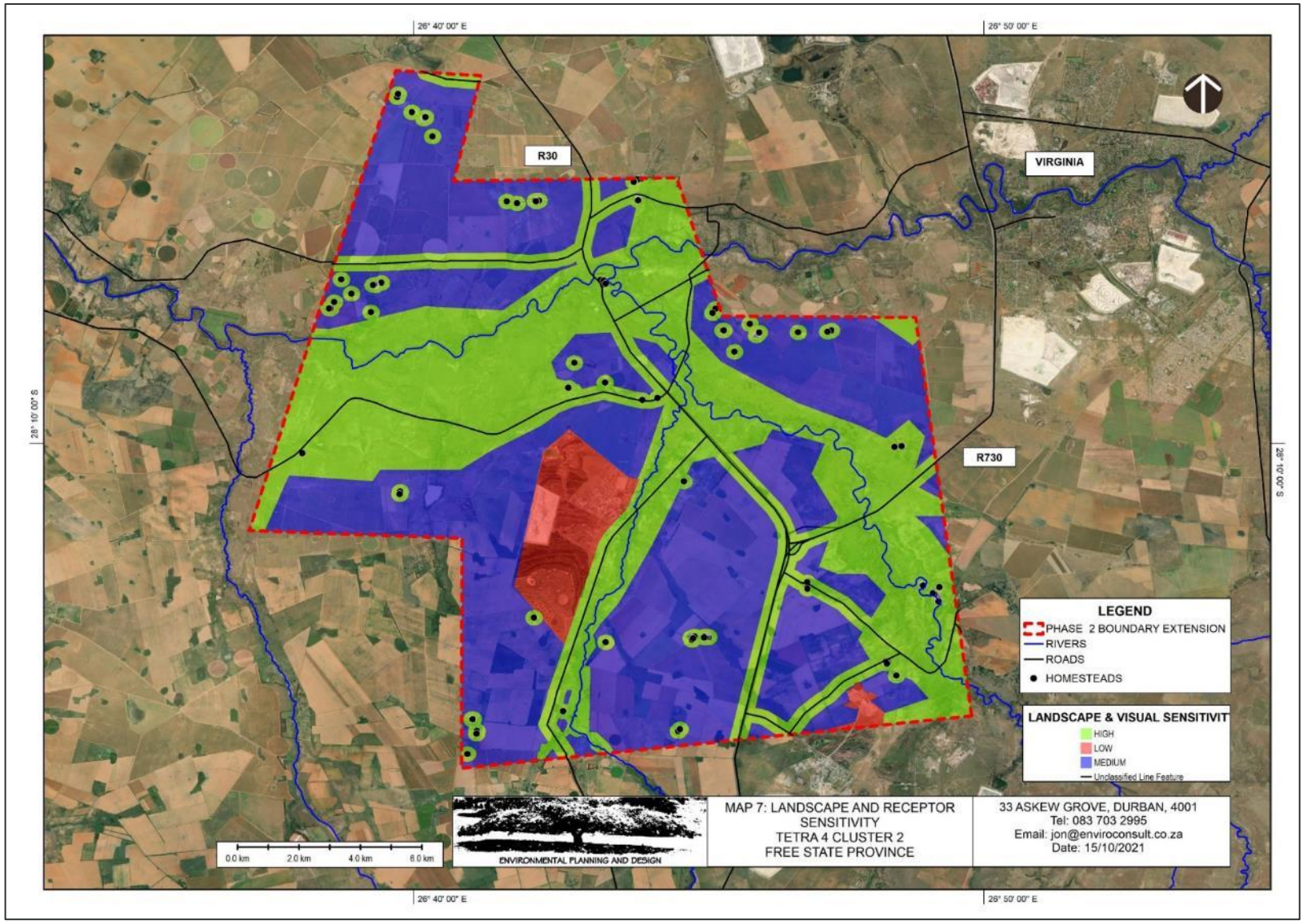


Figure 38: Landscape visual sensitivity rating for the study area.

8.2 BIOLOGICAL ENVIRONMENT

This section describes the biological environment within the project area, with a focus on the terrestrial and aquatic ecosystems that may be influenced by the proposed seismic survey. It provides an overview of the existing flora, fauna, habitats, and ecological processes, including areas of conservation significance and species of conservation concern. The information presented is based on available desktop data and specialist biodiversity assessments and serves to establish a baseline against which the potential biological impacts of the proposed activity are assessed.

8.2.1 FLORA

The Screening Tool indicates that no flora SCC are predicted to occur within the PAOI. Further, no flora SCC were confirmed during the site survey and none are likely to occur.

The Terrestrial Ecology Assessment for the proposed Tetra 4 Cluster 2 Project (TBC, 2022) recorded seven (7) protected and one (1) SCC flora species in various parts of the PAOI. Table 28 provides a list protected flora observed. These species are protected under the Free State Nature Conservation Ordinance 8 of 1969. According to the list of protected species under Schedule 6, if any individuals of these flora species are to be disturbed, permits must be obtained from the Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs (FSDESTEA).

Table 28:Protected and SCC flora recorded within the PAOI during the 2022 assessment. LC = Least Concern and NT = Near Threatened.

Family	Scientific Name	Threat Status (SANB)	SA Endemic
Amaryllidaceae	*Ammocharis coranica*	LC-Schedule 6 Protected	Not Endemic
Amaryllidaceae	*Boophone disticha*	LC-Schedule 6 Protected	Not Endemic
Asparagaceae	*Eucomis autumnalis*	LC-Schedule 6 Protected	Not Endemic
Asphodelaceae	*Aloe dominella*	Near Threatened B1ab(ii,iii,v) (-Schedule 6 Protected)	Endemic
Hyacinthaceae	*Schizocarphus nervosus*	LC-Schedule 6 Protected	Not Endemic
Iridaceae	*Gladiolus crassifolius*	LC-Schedule 6 Protected	Not Endemic
Iridaceae	*Gladiolus permeabilis*	LC-Schedule 6 Protected	Endemic

8.2.2 FAUNA

The Screening Tool indicates that one (1) mammal, two (2) avifauna, and one (1) sensitive species, SCC are predicted to occur within the PAOI. According to the list of protected species under Schedule 6, if any individuals of these flora species are to be disturbed, permits must be obtained from the Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs (FSDESTEA). Further, one (1) fauna SCC below were confirmed during the May 2022 site survey.

Please note that the Screening Tool report includes lists of bird, mammal, reptile, amphibian, butterfly, and plant SCC known or expected to occur in the proposed development footprint. Some of these SCCs are sensitive to illegal harvesting. Such species have had their names obscured and are listed as sensitive plant unique number

/ sensitive animal unique number. As per the best practise guideline that accompanies the protocol and screening tool, the name of the sensitive species may not appear in the final EIA report nor any of the specialist reports released into the public domain. It should be referred to as sensitive plant or sensitive animal and its threat status may be included, e.g. critically endangered sensitive plant or endangered sensitive animal.

Table 29: List of mammal Species of Conservation Concern that may occur in the PAOI. Endangered = EN, Least Concern = LC, NT = Near Threatened and VU = Vulnerable

Scientific Name	Common Name	Screening Tool Designation	Conservation Status		Habitat	Likelihood of Occurrence	Reason
			SANBI	IUCN			
Mammals							
Hydrictis maculicollis	Spotted-necked Otter	Medium	VU	NT	Unpolluted freshwater habitats rich in small fishes	Moderate	Some suitable habitat on site
Reptile							
Sensitive species 15	-	Medium	VU	VU	-	Confirmed	-
Avifauna							
Circus ranivorus	African Marsh Harrier	Medium	VU	LC	Coastal and inland wetlands, but may use adjacent grassland and croplands when foraging	Moderate	Some suitable habitat on site
Hydroprogne caspia	Caspian Tern	Medium	VU	LC	Natural and man-made waterbodies, showing preference for saline pans and large impoundments	Low	Minimal suitable habitat

8.2.3 ECOLOGY

The following is deduced from the National Web-based Environmental Screening Tool Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended):

- Terrestrial Biodiversity Theme sensitivity is 'Very High' for the PAOI due to the presence of a CBA 1, CBA 2, ESA 1, ESA 2, NPAES and the Endangered Vaal Vet Sandy Grassland vegetation type;
- Plant Species Theme sensitivity is 'Low' for the PAOI; and
- Animal Species Theme sensitivity is 'Medium' for the PAOI owing to the potential occurrence of four (4) SCC [viz. one (1) mammal, two (2) avifauna and one (1) Sensitive species].

The following sections discuss the results from the two field surveys that were conducted for the proposed project. Habitats observed at certain field points are described in Table 30.

Table 30: Sensitivity summary of the habitat types delineated within the PAOI.

Habitat	Description and condition	Ecosystem Processes and Services	Site Ecological Importance (SEI)
Degraded Grassland and Degraded Grassland No-Go	The Degraded Grassland habitat unit within the PAOI is degraded primarily across two vegetation types [*viz.* Vaal-Vet Sandy Grassland and the Highveld Alluvial vegetation unit]. This habitat is considered semi-natural but is notably degraded due to a combination of historic and ongoing pressures, including fragmentation, overgrazing by livestock, and human activities, particularly near roads. The degree of disturbance varies across the unit, with some areas experiencing more severe degradation, often linked to overgrazing or proximity to anthropogenic influences. Despite these disturbances, the habitat retains a suite of dominant indigenous plant species characteristic of the region, such as *Asparagus laricinus*, *Vachellia karroo*, *Searsia pyroides*, *Searsia lancea*, and *Ziziphus mucronata.* In areas closer to the Vaal-Vet Sandy Grassland, there is an increased presence of *Themeda triandra* and other herbaceous species, though the habitat overall is more representative of Highveld Alluvial vegetation in some patches. The presence of AIP species - including *Verbena incompta*, *Verbena litoralis*, *Oxalis corniculata*, *Tagetes minuta*, *Lactuca serriola*, and *Zinnia peruviana* - as well as edge effects, have further reduced habitat integrity, particularly impacting floral communities. While the flora community is no longer fully representative of reference vegetation due to	Despite the disturbances, the habitat maintains largely intact ecological functioning, particularly for faunal communities. It acts as a greenland, providing essential habitat, foraging areas, and movement corridors for a variety of fauna, including small mammals, reptiles, and ground-dwelling birds. The mix of grasses and shrubs offers forage, while plant clumps provide shade and shelter, supporting the survival of these species. Key ecosystem processes supported by this habitat include primary production, soil stabilization, nutrient cycling, and water regulation, all of which are enhanced by the remaining vegetation cover. The Degraded Grassland unit is also closely connected to water resource habitats, further underscoring its importance for hydrological processes and landscape connectivity. Although the habitat's plant community has been altered and is less representative of the reference state, the ecological services it provides remain significant. The sensitivity of the Degraded Grassland habitat reflects its crucial role in maintaining biodiversity within a highly fragmented landscape. The presence of AIP and edge effects may disrupt some ecological functions, such as pollination and seed dispersal, but the habitat's overall contribution to biodiversity, ecosystem resilience,	Very Low and Medium

Habitat	Description and condition	Ecosystem Processes and Services	Site Ecological Importance (SEI)
	ongoing and historic disturbances, the habitat still maintains elements of ecological function. The condition of the habitat is inconsistent, reflecting the varying intensity of land use and disturbance across the unit. Notably, one (1) reptile Sensitive Species 15 (SS15) were recorded in the northern section of the PAOI during the 2022 assessment. The species is listed as VU on both a regional and an international scale. The Degraded Grassland unit overlaps with several conservation planning categories, including CBA1, CBA2, ESA1, ESA2, and NPAES, highlighting its ecological significance despite its altered state.	and landscape connectivity remains substantial.	
			
Disturbed Grassland	The Disturbed Grassland habitat unit within the PAOI is found in both the Vaal-Vet Sandy Grassland and Highveld Alluvial vegetation units. This habitat has been significantly impacted by a combination of edge effects from adjacent modified or transformed areas, as well as direct anthropogenic pressures such as historic and ongoing overgrazing, vehicle ingress (including two-track roads), and other forms of human infringement. While not entirely transformed, these areas are in a persistent state of disturbance and are unable to recover to a more natural condition due to continual impacts from grazing, mismanagement, and harmful land	The ecological functioning and delivery of ecosystem services within the Disturbed habitat unit have been notably hindered by ongoing anthropogenic disturbances. Despite this, the habitat continues to provide several important ecosystem services. The remaining grass and shrub cover contributes to soil stabilization, helping to reduce both wind and water erosion. These areas also serve as movement corridors for a variety of fauna, supporting landscape connectivity even in a fragmented environment.	Very Low

Habitat	Description and condition	Ecosystem Processes and Services	Site Ecological Importance (SEI)
	use practices, including historic agriculture and dumping. The habitat is characterised by a higher level of degradation than the Degraded habitat, however, it is not as severely altered as the Transformed habitat unit. Indigenous plant species such as *Vachellia karroo*, *Delosperma floribundum*, *Cymbopogon caesius*, *Asparagus laricinus*, and *Wahlenbergia undulata* are still present, but overall floral species richness is diminished as a result of ongoing anthropogenic influences. Faunal species observed in this habitat include *Xerus inauris*, *Sylvicapra grimmia*, and *Raphicerus campestris*. The overall sensitivity of this habitat is considered medium, as it often serves as a buffer or barrier between more natural and more heavily transformed areas, and may be used as a movement corridor for fauna.	However, the persistent disturbances - such as overgrazing, vehicle ingress, dumping, and mismanagement - have led to a reduction in floral diversity and a decline in the overall health of ecological processes. The diminished plant community limits the habitat's capacity for natural regeneration and reduces the availability of resources for both flora and fauna. While the habitat is not entirely transformed, its ability to support robust ecosystem functioning is compromised, and its role is increasingly that of a transitional or buffer zone between more intact and more heavily altered landscapes. Nevertheless, the habitat remains ecologically significant for maintaining some level of biodiversity, providing erosion control, and facilitating wildlife movement within the Vaal-Vet Sandy Grassland and Highveld Alluvial regions.	
			
Transformed	The Transformed habitat unit is the largest within the PAOI and is characterised by extensive alteration of the natural landscape, primarily as a result of historical and ongoing mining and agricultural activities, as well as the development of associated infrastructure such as roads and substations. This habitat unit is defined by a near-complete loss of natural vegetation cover, with the	Ecological functioning and the provision of ecosystem services within the habitat unit have been severely degraded due to the extensive anthropogenic influences. The dominance of impermeable surfaces, manicured lawns, and infrastructure has resulted in the near-total loss of natural ecosystem processes such as nutrient cycling, water infiltration, and habitat provision	Very Low

Habitat	Description and condition	Ecosystem Processes and Services	Site Ecological Importance (SEI)
	landscape now dominated by agricultural fields, infrastructure, and other impermeable surfaces. The transformation is so extensive that the habitat exists in a perpetually altered state, unable to recover to a more natural condition due to continuous disturbance and land use impacts. No SCC were observed within this unit, nor are any expected, given the lack of suitable habitat and the dominance of non-native or highly disturbed environments. The habitat unit does not contribute to the ecological representation of the EN ecosystem and holds no conservation value from an ecological perspective. Despite the overlap with conservation planning categories such as CBA1, CBA2, ESA1, ESA2, and NPAES, the current condition of this habitat precludes it from supporting significant biodiversity or functioning as a viable conservation area.	for native species. The remaining indigenous species are sparse, but may provide limited benefits to adjacent areas, such as wind-dispersed seeds that could potentially aid in the recolonization of nearby less-disturbed habitats. The ecological services provided by this habitat are extremely limited. While certain sections may still function as movement corridors for locally common fauna, the overall capacity of the Transformed unit to support biodiversity, regulate water, or stabilize soil is minimal. The habitat's ongoing transformed state, driven by persistent agricultural and infrastructural activities, ensures that it remains ecologically compromised and unable to recover or contribute meaningfully to the broader landscape's ecological integrity.	
 			
Water Resources	The habitat unit within the PAOI encompasses a diverse array of aquatic and semi-aquatic features, including wetlands, rivers, and drainage systems. Notably, SAIIAE wetlands are recorded within 500 meters of the PAOI, and several wetland types *viz*. Depressions (PP), Channelled Valley-Bottom (NP), and Seep (NP) are present both within and around the area.	The habitat unit plays a pivotal role in sustaining ecological processes and delivering a wide range of ecosystem services within the PAOI. Wetlands, rivers, and riparian zones contribute significantly to the hydrological cycle, supporting water balance through processes such as evapotranspiration and groundwater recharge. These	Medium

Habitat	Description and condition	Ecosystem Processes and Services	Site Ecological Importance (SEI)
	The conservation status of these wetlands varies, with Depressions listed as 'Least Concern' (LC), while Channelled Valley-Bottom and Seep wetlands are classified as 'Critical' (CR), highlighting their ecological importance and vulnerability. Three rivers *viz*. Sand, Doring, and Bosluisspruit overlap with the PAOI, contributing to the hydrological complexity and ecological value of the area. The riparian zones associated with these rivers, particularly the Sand River and its tributaries, are characterised by riparian vegetation that, despite being in a relatively modified and poor condition due to invasive species, bank erosion, and overgrazing, still provide essential ecological functions. These areas are subject to ongoing anthropogenic pressures, however retain high conservation value due to their role in supporting biodiversity and maintaining ecosystem processes. The Water Resources habitat unit is considered to be of high ecological sensitivity. It provides unique habitats for a variety of faunal and floral species, including species of conservation concern *viz. Aonyx capensis* (NT), which has been previously recorded in the area. The ecological integrity and functioning of these water resource systems are crucial for the maintenance of local and regional biodiversity, as well as for the provision of essential ecosystem services.	systems are vital for water regulation, flood attenuation, and the maintenance of water quality. Riparian and wetland habitats serve as critical corridors for faunal migration and dispersal, enhancing landscape connectivity and supporting the movement of both common and SCC. They provide essential habitat and foraging grounds for a diverse array of wildlife, including the Cape Clawless Otter and other species of conservation concern. The vegetation within these habitats stabilizes banks, reduces erosion, and filters pollutants, thereby maintaining the ecological health of the broader landscape. Despite some disturbance from invasive species, erosion, and overgrazing, the ecological importance and functioning of these water resource systems remain high. Their preservation is essential, not only for maintaining biodiversity and ecosystem resilience but also for supporting the livelihoods and well-being of surrounding communities. The high sensitivity of these areas, as indicated by various ecological datasets, underscores the need for their protection and enhancement, particularly in the context of any proposed development within the PAOI. For further detail on the condition, sensitivity, and management recommendations for these systems, the accompanying Wetland - and Aquatic Report (TBC, 2026) should be consulted.	

Habitat	Description and condition	Ecosystem Processes and Services	Site Ecological Importance (SEI)
			

Four (4) main habitat types were identified across the PAOI and include:

- Degraded Grassland;
- Disturbed Grassland;
- Transformed and
- Water resources and Buffers.

The habitat units for the PAOI can be seen delineated in Figure 39 and a description of the habitat units can be found in Table 30.

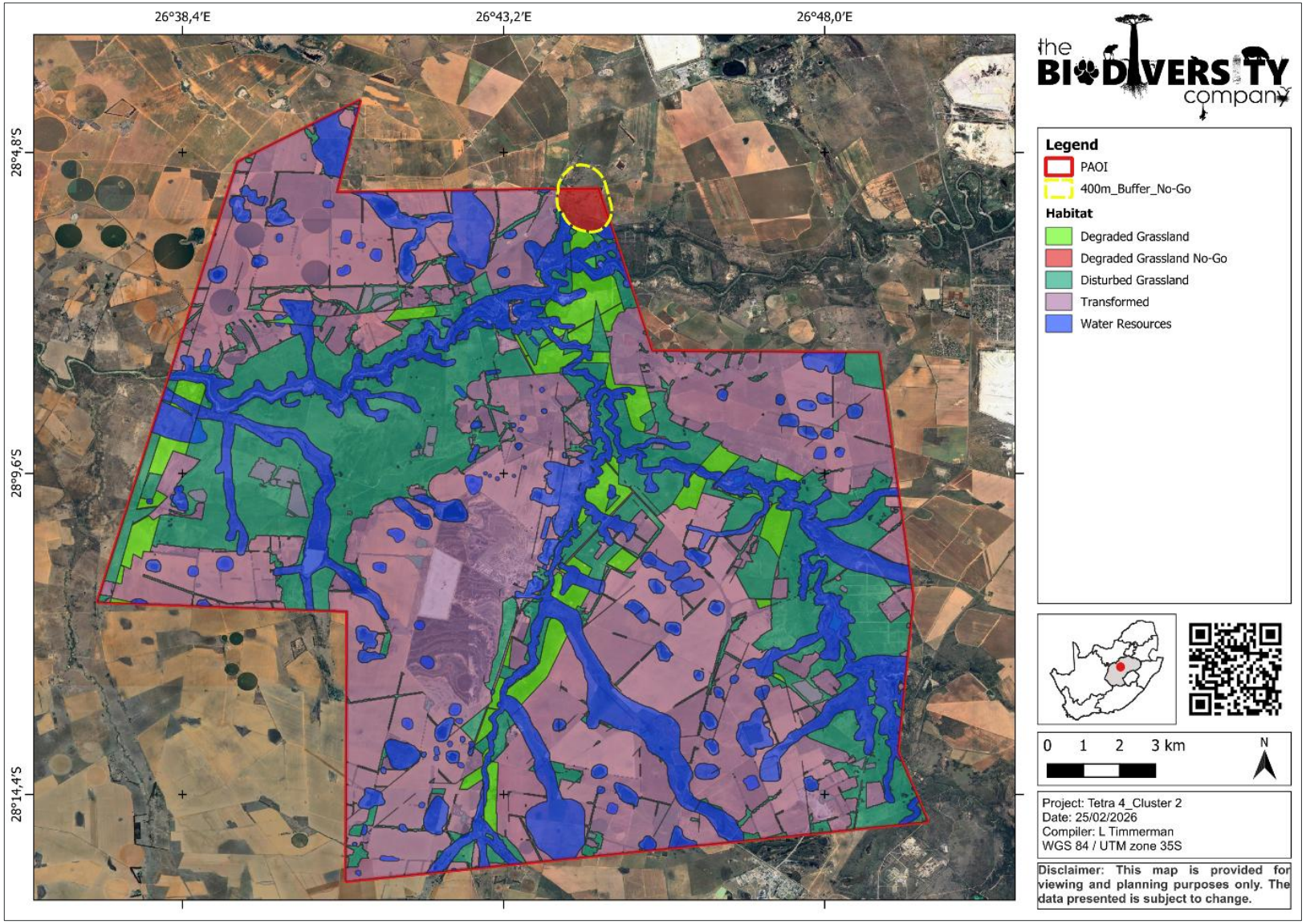


Figure 39: Habitats identified within the PAOI

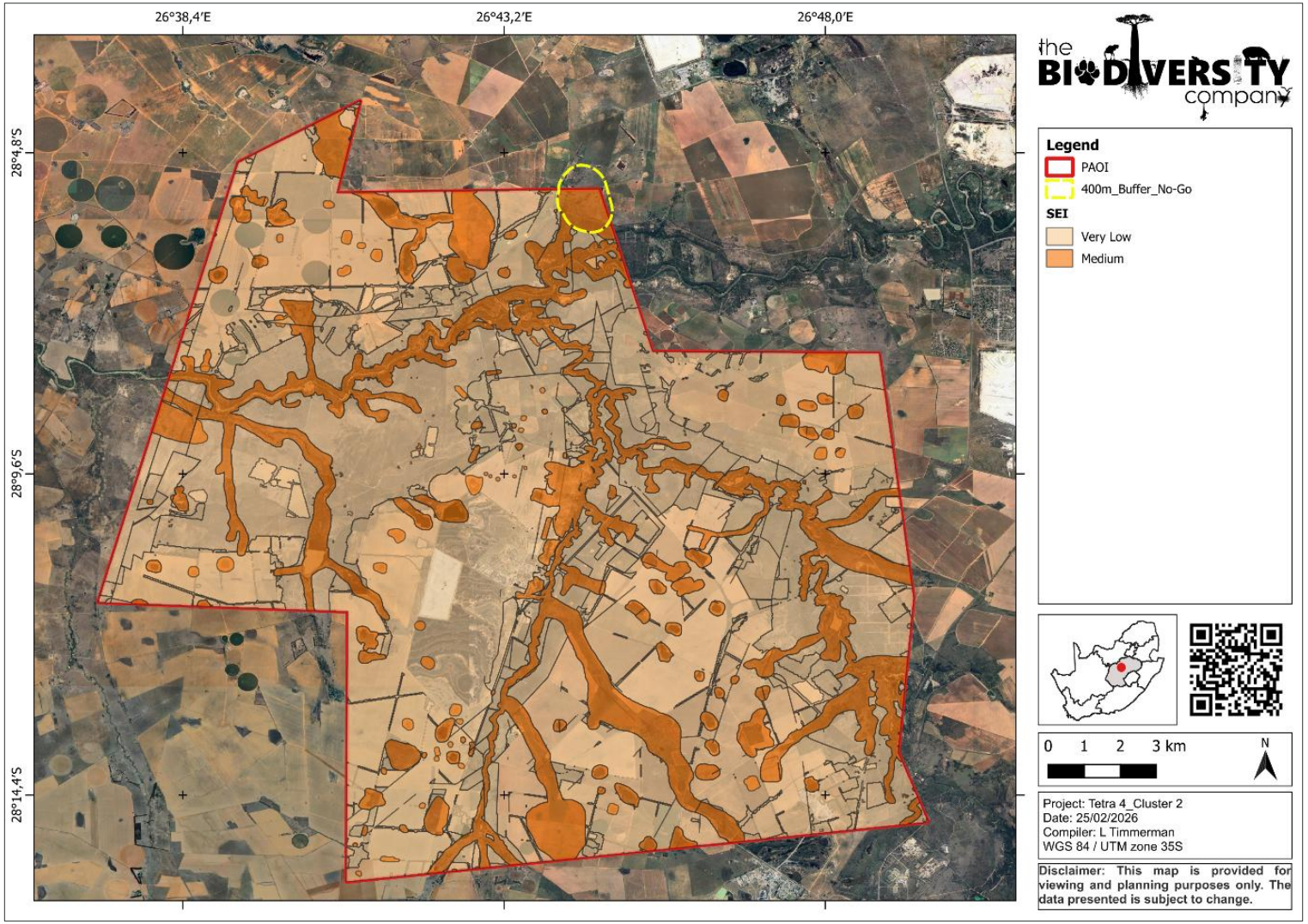


Figure 40: Map depicting the Site Ecological Importance (SEI) sensitivity for the PAOI.

8.2.4 AQUATIC AND WETLANDS

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) wetland dataset is a recent outcome of the National Biodiversity Assessment (NBA, 2018) and, was a collaborative project by the South African National Biodiversity Institute (SANBI) and the Council for Scientific and Industrial Research (CSIR). The SAIIAE dataset provides further insight into wetland occurrences and extents building on the information from the NFEPA, as well as other datasets. Multiple systems were identified within the 500 m PAOI of the project footprint (see Figure 3 1). These systems were identified as being depression wetlands.

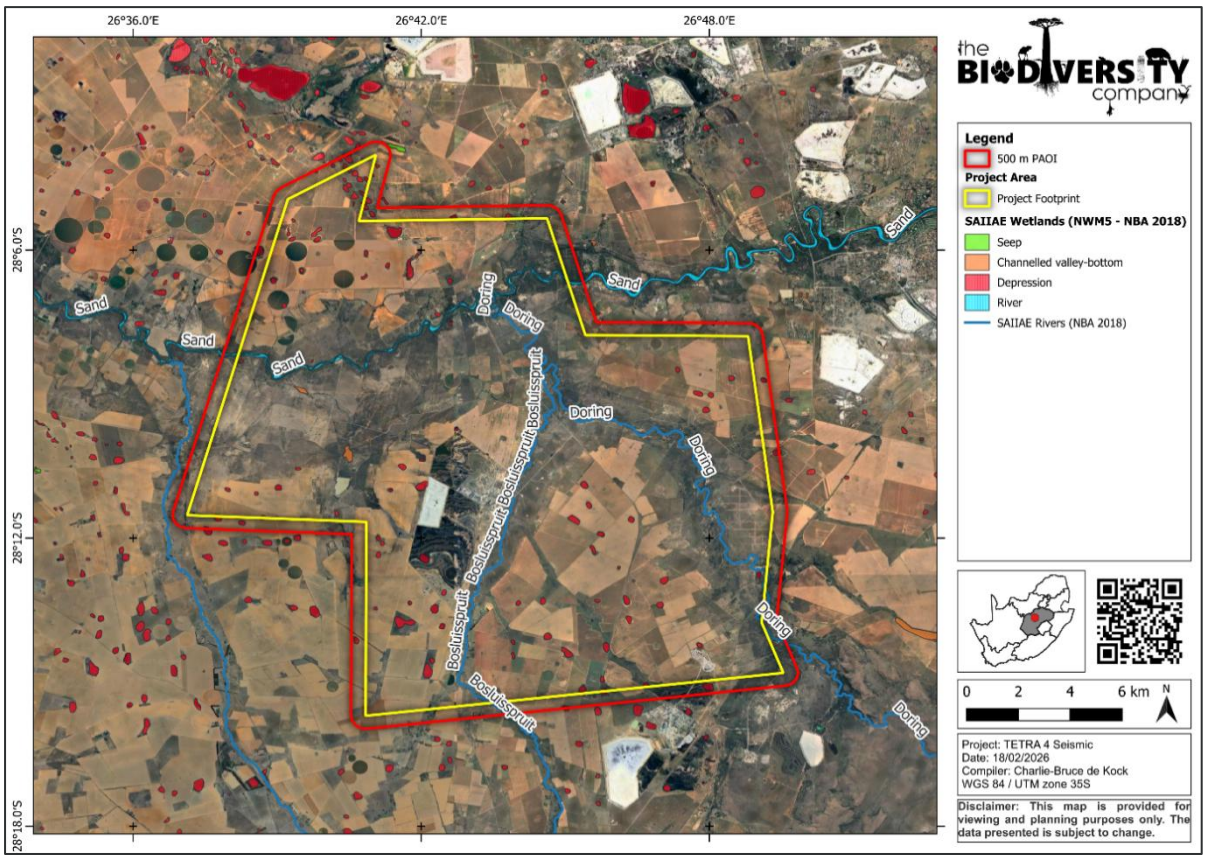


Figure 41: Wetland features identified within the project area of influence according to the South African Inventory of Aquatic Ecosystems dataset.

8.2.4.1 NATIONAL FRESHWATER ECOSYSTEM PRIORITY AREA STATUS

The NFEPA database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the NWA. This directly applies to the NWA, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of RQOs (Nel et al., 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the NEMBA, informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel et al., 2011).

The project area falls across five SQRs with several NFEPAs listed within the project area (Table 31). These FEPAs are associated with wetland type ecosystems and NFEPA River status designated to the watercourses within the project area (Figure 42).

Conserving the water quality, riverine and wetland habitat and associated ecological functioning within the project area and associated SQRs, will aid in the protection of riverine habitat supporting fish species occurring within the entire catchment and water quality for the aquatic and terrestrial biota downstream of the project area. The SQR's in which human activities occur need to be managed to maintain water quality and prevent

further degradation of downstream water resources in order to contribute to national biodiversity goals and support sustainable use of water resources.

Table 31: NFEPAs listed for the project area.

Type of FEPA map category	Biodiversity features
Doring River C42K-2754	
Wetland ecosystem type	3 WetCluster FEPAs
Wetland ecosystem type	Dry Highveld Grassland Group 3_Channelled valley-bottom wetland
Wetland ecosystem type	Dry Highveld Grassland Group 3_Depression
Wetland ecosystem type	Dry Highveld Grassland Group 3_Flat
Wetland ecosystem type	Dry Highveld Grassland Group 3_Seep
Wetland ecosystem type	Dry Highveld Grassland Group 3_Unchannelled valley-bottom wetland
Wetland ecosystem type	Dry Highveld Grassland Group 4_Channelled valley-bottom wetland
Wetland ecosystem type	Dry Highveld Grassland Group 4_Flat
Wetland ecosystem type	Dry Highveld Grassland Group 4_Seep
Wetland ecosystem type	Dry Highveld Grassland Group 4_Unchannelled valley-bottom wetland
Wetland ecosystem type	Dry Highveld Grassland Group 4_Valleyhead seep
Boschluispruit C42K- 2764	
Wetland ecosystem type	Dry Highveld Grassland Group 3_Channelled valley-bottom wetland
Wetland ecosystem type	Dry Highveld Grassland Group 3_Depression
Wetland ecosystem type	Dry Highveld Grassland Group 3_Flat
Wetland ecosystem type	Dry Highveld Grassland Group 3_Seep

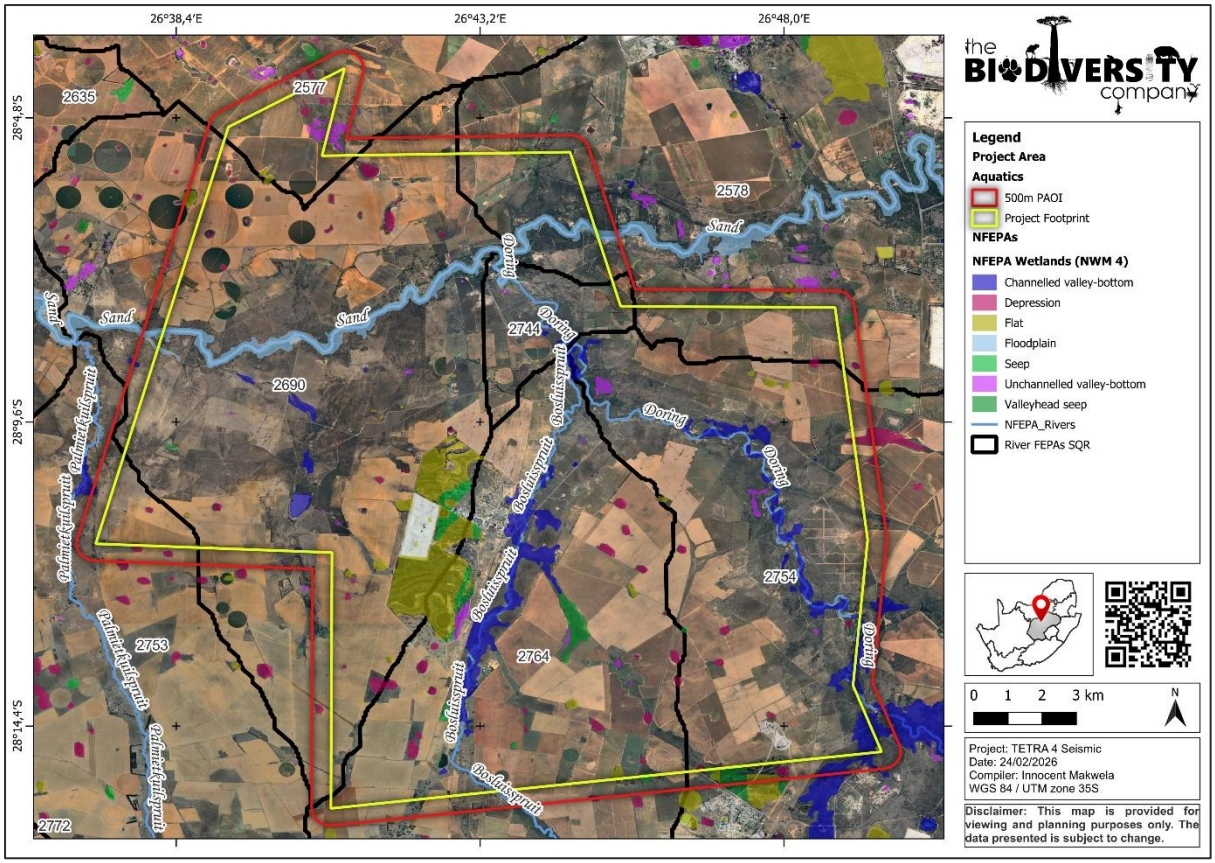


Figure 42: NFEPA map for the PAOI (Nel et al., 2011).

8.2.4.2 **RIVERINE ECOLOGY**

Tetra4 Cluster 2 is located within the Matjhabeng Local Municipality, approximately 17 km south of Welkom and 11 km west of Virginia in the Free State Province. The project area is drained by several ephemeral and perennial watercourses, which fall within the C42J, C42L and C42K quaternary catchments, and the Vaal_Orange WMA (DWS, 2023). The eastern portion of the project area falls within the C42K quaternary catchment and ephemeral systems drain into the Boschluisspruit and Doring Rivers which eventuate into the Sand River at the catchment boundary. The eastern portion of the project area falls within the C42L quaternary catchment and consists of several small ephemeral systems which drain into the Sand River. The Sand River flows west into the Vet River, which has its confluence with the Vaal River 87 km west within the Bloemhof Dam. The elevation ranges between 1338 meters above sea level (masl) in the upper reaches of the Doring River to 1282 masl on the Sand River at the outlet of the project area. The spatial framework for the PES assessment of the watercourses falls within the Vaal WMA and includes the Boschluispruit, Doring River and Sand River, as well as several unnamed tributaries.

The spatial framework for the PES assessment of the watercourses falls within the Vaal_Orange WMA and includes the perennial systems Boschluispruit, Doring River and Sand River, as well as several unnamed ephemeral tributaries. The Sand River is classified as a lowland river, with a low gradient alluvial fine bed and meandering channel. A distinctive macro-channel is visible with sand and silt deposits occurring throughout the reach. Riparian zone is well developed. The upper reaches of the Boschluispruit are characteristic of upper foothills geoclass and develop into lower foothills. The riparian zone is poorly defined, and wetland delineations provide a more robust delineation of the watercourse. The Doring River is classed as lower foothills, with incised channels, limiting the lateral movement of water.

The Sand River is represented by two Sub-Quaternary Reaches (SQRs), namely the C42J-2716 and C42L-2690. The Doring is represented by the C42K-2754 and C42K-2744 SQRs. The Boschluispruit is represented by a single SQR, C42K- 2764. The Present Ecological State (PES) of the rivers range from largely natural (class B) to moderately modified (class C) within the region. Impacts to the watercourses are attributed to runoff from

mining, agricultural activities, urban areas (Virginia) and flow modifications. The activities have contributions to water quality perturbations and impacts to instream habitat, erosion of channel and banks, and proliferation of alien vegetation.

A single riverine sampling survey was conducted on the 14th of March 2022 to 18th of March 2022. The survey constituted a wet season/ high flow/ summer assessment. Table 32 presents site photographs for the study and the Global Positioning System (GPS) coordinates. It should be noted that several sites were dry and access to two sites was limited at the time of the survey.

A follow up riverine sampling survey was conducted on the 2nd of February 2026. The survey also constituted a wet season assessment. The surveys were completed to support the compliance statement. Due to the numerous systems intersected by the proposed project area, selected rivers systems are presented below to illustrate the various freshwater features and riparian zones encountered (Table 33).

Table 32: Investigation site photographs and coordinates (March 2022).

Site	Upstream View	Downstream View
Sand River		
S1		
Comments	Upstream Sand River site. Substrate dominated by sand and scattered stones of current. Debris within the channel provides cover features for aquatic biota. Flooding conditions during sampling.	
GPS-coordinates	28° 5'55.27"S 26°50'2.40"E	
S2		
Comments	Midstream Sand River site. Flooding conditions during sampling. Substrate dominated by sand and portions of bedrock.	
GPS-coordinates	28° 7'4.26"S 26°43'9.48"E	

Site	Upstream View	Downstream View
S3		
Comments	Downstream Sand River site. Flooding conditions during sampling. Instream habitat limited, predominantly sand substrate.	
GPS-coordinates	28° 7'21.92"S 26°35'7.29"E	
Doring River		
D1		
Comments	Upstream Doring River site. Limited instream habitat diversity and hydraulic biotopes.	
GPS-coordinates	28°11'17.45"S 26°47'53.81"E	
D2		
Comments	Downstream Doring River site. Limited instream habitat diversity and hydraulic biotopes.	
GPS-coordinates	28° 7'36.76"S 26°43'57.13"E	
Palmietkuilspruit		

Site	Upstream View	Downstream View
P1		
Comments	Reference site on the Palmietkuilspruit. Diverse habitat including stones and marginal vegetation.	
GPS-coordinates	28°10'30.53"S 26°36'57.33"E	
Boschluispruit		
B0		
Comments	Upstream site on Boschluispruit, characteristic of wetland system.	
GPS-coordinates	28°15'12.51"S 26°42'31.37"E	
B3		
Comments	Wetland system in downstream reaches of Boschluispruit	
GPS-coordinates	28° 9'20.92"S 26°44'39.94"E	
Ephemeral Tributaries		

Site	Upstream View	Downstream View
K1		
Comments	Site downstream of mining activities, outside of project area. Flows into the Sand River upstream of project area.	
GPS-coordinates	28° 5'36.28"S 26°48'20.94"E	
T0		
Comments	Ephemeral tributary. Site limited to a standing pool.	
GPS-coordinates	28° 9'35.66"S 26°40'29.93"E	
T1		
Comments	Ephemeral tributary with limited surface water	
GPS-coordinates	28° 9'6.98"S 26°40'11.16"E	

Table 33: Investigation site photographs and coordinates (February 2026).

Site	Upstream	Downstream
Sand River		

Site	Upstream	Downstream
S2		
Comments	Midstream Sand River site. Substrate dominated by sand and portions of bedrock.	
GPS-coordinates	28° 7'4.26"S 26°43'9.48"E	
S3		
Comments	Downstream Sand River site. Instream habitat limited, predominantly sand substrate.	
GPS-coordinates	28° 7'21.92"S 26°35'7.29"E	
Doring River		
D1		
Comments	Upstream Doring River site. Limited instream habitat diversity and hydraulic biotopes.	
GPS-coordinates	28°11'17.45"S 26°47'53.81"E	

Site	Upstream	Downstream
D2		
Comments	Downstream Doring River site. Limited instream habitat diversity and hydraulic biotopes.	
GPS-coordinates	28° 7'36.76"S 26°43'57.13"E	
Boschluispruit		
B1-NEW		
Comments	Upstream site on Boschluispruit, characteristic of wetland system.	
GPS-coordinates	28°13'7.16"S 26°43'10.59"E	
B3		
Comments	Wetland system in downstream reaches of Boschluispruit	
GPS-coordinates	28° 9'20.92"S 26°44'39.94"E	
Impoundment		

Site	Upstream	Downstream
Dam		
Comments	Impoundment on the upper reaches of one of the Ephemeral Tributaries of the Sand River	
GPS-coordinates	28°11'2.48"S 26°40'13.24"E	
Ephemeral Tributaries		
T0		
Comments	Ephemeral tributary of the Sand River. Site was dry at the time of the survey.	
GPS-coordinates	28° 9'35.66"S 26°40'29.93"E	
T1 NEW		
Comments	Ephemeral tributary of the Sand River with limited surface water	
GPS-coordinates	28° 5'40.48"S 26°44'5.72"E	

8.2.4.3 EXPECTED FISH SPECIES

An expected species list was generated from DWS (2014), and Skelton (2011, 2016, and 2024) for the C23H-01653 SQR's. A total of 10 fish species are expected to occur in the Sand River region which are presented in Table 34. The conservational status of fish species was assessed against the latest IUCN database (IUCN, 2025).

The expected species are generated on a reach basis, and the occurrence of all species in the system is unlikely as different species are specialists of different habitats which are present along a reach. The Sand River reach

does however have limited habitat diversity and cover features which would likely limit the diversity of the fish community. A single species of conservational concern is expected within the reach and downstream systems, *Labeobarbus kimberleyensis* (Largemouth yellowfish) which is listed as Near Threatened (NT). The species is on decreasing population trend and is threatened by deterioration in water quality including eutrophication (nutrient enrichment through poor farming practices and inefficient wastewater treatment), loss of habitat and habitat fragmentation due to weirs and dams, loss of spawning grounds due to instream sedimentation (related to erosion), flow modifications due to drought and dam releases, and threats from exotic species, namely Common Carp (Cyprinus carpio) and Grass Carp (*Ctenopharyngodon idella*) (IUCN, 2025).

Table 34: Expected fish species for the SQRs sampled for the project.

Species	Common Name	IUCN (2025)	C42L-2690 (Sand)	C42K-2754 (Doring)	C42K- 2764 (Boschluispruit)
Austroglanis sclateri	Rock-catfish	LC	1	1	-
Clarias gariepinus	Sharptooth catfish	LC	1	1	-
Enteromius anoplus	Chubby head barb	LC	1	1	1
Enteromius paludinosus	Straightfin barb	LC	1	1	1
Labeo capensis	Mudfish	LC	1	1	1
Labeo umbratus	Moggel	LC	1	1	1
Labeobarbus aeneus	Smallmouth yellowfish	LC	1	1	1
Labeobarbus kimberleyensis	Largemouth yellowfish	NT	1	1	-
Pseudocrenilabrus philander	Southern mouthbrooder	LC	1	1	-
Tilapia sparrmanii	Banded tilapia	LC	1	1	-
Total expected species	10	-	10	10	5

LC - Least concern

NT - Near Threatened

NA - Not assessed

8.2.4.4 RESOURCE QUALITY OBJECTIVES

Results from the aquatic assessment are compared to the Resource Quality Objectives (RQOs) for the Vaal WMA, Integrated Unit of Analysis MD2 Lower Sand, Resource Unit LS3 (DWS, 2016). The Resource Units (RU) are presented in Table 35 and the RQOs for the units are presented in Table 36. The stipulated RQOs should be considered for the Environmental Management Plan and monitoring protocols should EA be granted for this project. Each aspect of the aquatic assessment will be presented along with relevant RQOs.

Table 35: Summary of resources assigned RQOs for the relevant Sand River region.

Integrated Unit of Analysis (IUA)	RU	Water Resource Class for IUA	Quaternary Catchment	Mean Annual Runoff (MAR)	Present Ecological State	Recommended Ecological Category
Lower Sand River (MD2)	LS3	III	C42L	180.27	C	C

Table 36: Resource Quality Objectives for the sand River Resource Unit (RU) LS3.

RU	Quaternary Catchment	Component	Component Sub-	Resource Quality Objective	Indicator/measure	Numerical limit
LS3	C42K, C42L, C43B	Quality	Salts	Salinity levels are significantly high. Instream salinity must be improved to support the aquatic ecosystem and the water quality requirements of the water users.	Electrical conductivity	≤ 85 milliSiemens/metre
LS3	Lower Sand (C42J) (Downstream Rietspruit tributary to confluence with the Vet River)	Quality	System variables	pH must be maintained at present state.	pH range	6.5 - 9.2
		Habitat	Instream Habitat	Instream and Riparian habitat must be in a moderately modified condition or better.	The Rapid Habitat Assessment Method must be implemented.	Instream and Riparian habitat Integrity category ≥ C (≥ 62)
		Biota	Fish	Instream biota must be in moderately modified condition or better through maintenance of habitat, flows, water quality.	A baseline assessment to determine the integrity and health of the fish community should be conducted to determine the current state and potential impacts to the population. Fish Response Assessment Index (FRAI) must be utilized.	Fish ecological category: ≥ C (≥ 62) Macro-invertebrate ecological category: ≥ C (≥ 62) Instream Ecostatus category ≥ C (≥ 62) With monthly flow requirements as specified. Water Quality category: ≥ C (≥ 62)

RU	Quaternary Catchment	Component	Component Sub-	Resource Quality Objective	Indicator/measure	Numerical limit
			Aquatic Invertebrates	The integrity of the macroinvertebrate community within the system must be maintained.	The integrity of the invertebrate community should be determined using the Macroinvertebrate Response Assessment Index. Conduct aquatic biomonitoring annually using the South African scoring System 5 methodology.	Maintain the D ecological category by ensuring that the Average Score Per Taxon is >5

8.2.4.5 **WETLANDS**

Wetland units have been grouped based on the Hydrogeomorphic (HGM) type and ecological condition. It is assumed that systems of the same type and that are positioned in a similar landscape setting are likely to provide similar ecological services.

Four (4) HGM types were identified within the PAOI (Figure 43), namely, channelled valley-bottoms (CVB), unchannelled valley-bottoms (UVB), seeps and depression wetlands. This assessment utilised baseline data from previous wetland assessments conducted within the project area (such as the Tetra4 Phase 2 EIA), supplemented by targeted field surveys to ground-truth previously unassessed locations. Consequently, the wetland delineations align with those established in the Phase 2 EIA, with the inclusion of additional seasonal drainage lines identified during the recent on-site verification.

In addition to these, non-perennial drainage lines were identified within the PAOI. These features are referred to as an 'A' Section channel that conveys surface runoff immediately after a storm event and is not associated with a baseflow (DWAF, 2005).

Along with these natural features, multiple artificial features, namely dams and artificial wetlands, were identified within the PAOI. According to Ollis et al., (2013) a dam is classified as 'an artificial body of water formed by the unnatural accumulation of water behind an artificial barrier that has been constructed across a river channel or an unchannelled valley-bottom wetland'. Although these systems do not classify as a natural wetland system it is important to note where the dams are for any planned development in the area.

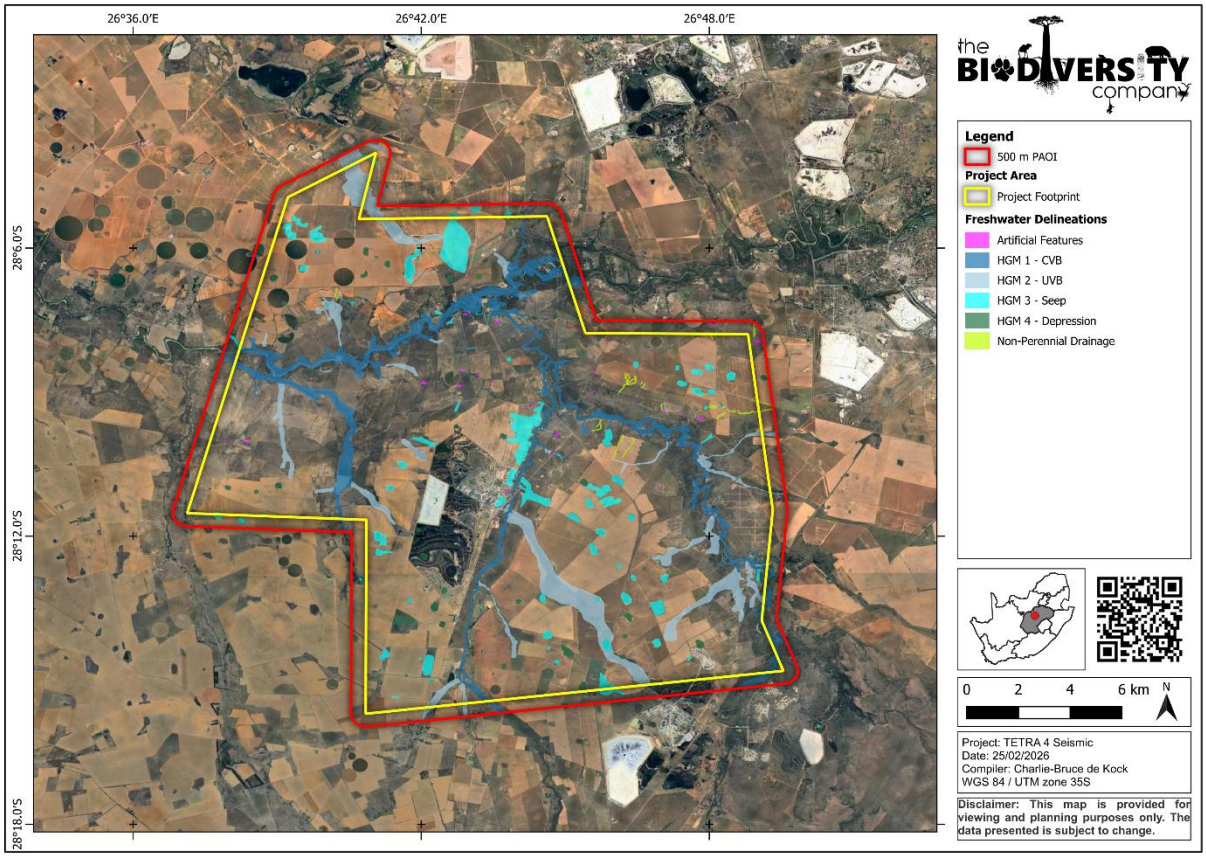


Figure 43: Delineation of wetlands and artificial features within the project area of influence.

The wetland classification as per SANBI guidelines (Ollis et al., 2013) is presented in Table 37.

Table 37: Wetland classification as per SANBI guideline (Ollis et al., 2013).

Wetland Unit	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	Highveld	Dry Highveld Grassland Group 3	Valley Bottom	CVB	N/A	N/A
HGM 2				Valley Bottom	UVB	N/A	N/A
HGM 3				Bench	Seep	Without channelled outflow	N/A
HGM 4				Bench	Depression	Endorheic	Without outflow

A channelled valley-bottom wetland, is a wetland ecosystem located along a valley floor, characterised by the presence of a river channel running through it (Ollis et al., 2013). These wetlands are distinct from floodplain wetlands due to the absence of characteristic floodplain features and the presence of a defined river channel. The landscape setting of a channelled valley-bottom wetland typically involves a valley floor where the wetland receives water inputs from the river channel, either as surface flow during flooding or as subsurface flow, and

from adjacent valley side-slopes through overland flow or interflow. The hydrodynamics of these wetlands are influenced by the river channel, which provides a concentrated flow of water, contributing to the wetland's ecological functions such as sediment trapping, nutrient cycling, and habitat provision. This setting makes channelled valley-bottom wetlands crucial for maintaining the ecological integrity of riverine systems and supporting biodiversity.

An unchannelled valley-bottom wetland, is a wetland located on a valley floor, characterised by the absence of a distinct river channel (Ollis et al., 2013). These wetlands are defined by their diffuse water flows, which are not confined within channel banks, allowing water to spread across the valley floor. The primary water inputs for unchannelled valley-bottom wetlands include diffuse surface and subsurface flows from upstream channels that lose confinement, as well as seepage from adjacent valley side-slopes. The hydrodynamics of these wetlands are dominated by horizontal, unidirectional, diffuse surface flow, although infiltration and evapotranspiration can also be significant. This setting allows unchannelled valley-bottom wetlands to function as important sites for sediment deposition, water filtration, and habitat provision, supporting a diverse range of plant and animal species. Their unique hydrological and geomorphological characteristics make them vital components of the landscape, contributing to the overall ecological health of the valley systems in which they occur.

A seep wetland is typically located on gently to steeply sloping land and is characterised by the colluvial, unidirectional movement of water and material down-slope (Ollis et al., 2013). Seeps are often found on the side-slopes of a valley but do not usually extend onto the valley floor. The primary water inputs for seeps are subsurface flows from an up-slope direction, with water movement through the seep mainly occurring as interflow. During and after rainfall events, diffuse overland flow, known as sheetwash, can also be significant. Seeps are associated with geological formations and topographic positions that either cause groundwater to discharge to the land surface or rain-derived water to seep down-slope as subsurface interflow. This unique hydrological setting allows seeps to support specific vegetation adapted to these conditions, contributing to their ecological significance in the landscape.

A depression wetland is characterised by its distinct geomorphological features (Ollis et al., 2013). These wetlands are defined by closed or near-closed elevation contours, which increase in depth from the perimeter to a central area of greatest depth, where water typically accumulates. Depressions may be flat-bottomed, often referred to as pans, or round-bottomed, and can have various combinations of inlets and outlets or lack them entirely. The hydrodynamics of a depression are typically dominated by vertical water level fluctuations, with water inputs primarily from precipitation, groundwater discharge, interflow, and diffuse or concentrated overland flow. The classification system further categorizes depressions based on their outflow drainage characteristics as exorheic (outward-draining), endorheic (inward-draining), or dammed, and by their inflow drainage characteristics as with or without channelled inflow. This detailed classification helps in understanding the ecological functions and management needs of depression wetlands in South Africa.

8.3 SOCIAL ENVIRONMENT

According to NEMA, environment refers to the surroundings in which humans exist. When viewing the environment from a socio-economic perspective the question can be asked what exactly the social environment is. Different definitions for social environment exist, but a clear and comprehensive definition that is widely accepted remains elusive. Barnett & Casper (2001) offers the following definition of human social environment:

> *"Human social environments encompass the immediate physical surroundings, social relationships, and cultural milieus within which defined groups of people function and interact. Components of the social environment include built infrastructure; industrial and occupational structure; labour markets; social and economic processes; wealth; social, human, and health services; power relations; government; race relations; social inequality; cultural practices; the arts; religious institutions and practices; and beliefs about place and community. The social environment subsumes many aspects of the physical environment, given that contemporary landscapes, water resources, and other natural resources have been at least partially configured by human social processes. Embedded within contemporary social environments are historical social and power relations that have become institutionalized over time. Social environments can be experienced at*

multiple scales, often simultaneously, including households, kin networks, neighbourhoods, towns and cities, and regions. Social environments are dynamic and change over time as the result of both internal and external forces. There are relationships of dependency among the social environments of different local areas, because these areas are connected through larger regional, national, and international social and economic processes and power relations."

Environment-behaviour relationships are interrelationships (Bell, Fisher, Baum & Greene, 1996). The environment influences and constrains the behaviour of people, but behaviour also leads to changes in the environment. The impacts of a project on people can only be truly understood if their environmental context is understood. The baseline description of the social environment includes a description of the area within a provincial, district and local context that will focus on the identity and history of the area as well as a description of the population of the area based on a number of demographic, social and economic variables.

8.3.1 DESCRIPTION OF THE AREA

The proposed site for the Cluster 2 project is located in Wards 9 and 24 of the Matjhabeng Local Municipality and Ward 6 of the Masilonyana Local Municipality that forms part of the Lejweleputswa District Municipality in the Free State Province. The baseline description of the environment will include these areas. Figure 44 shows the location of the proposed Cluster 2 project as well as some social and physical infrastructure in the area.

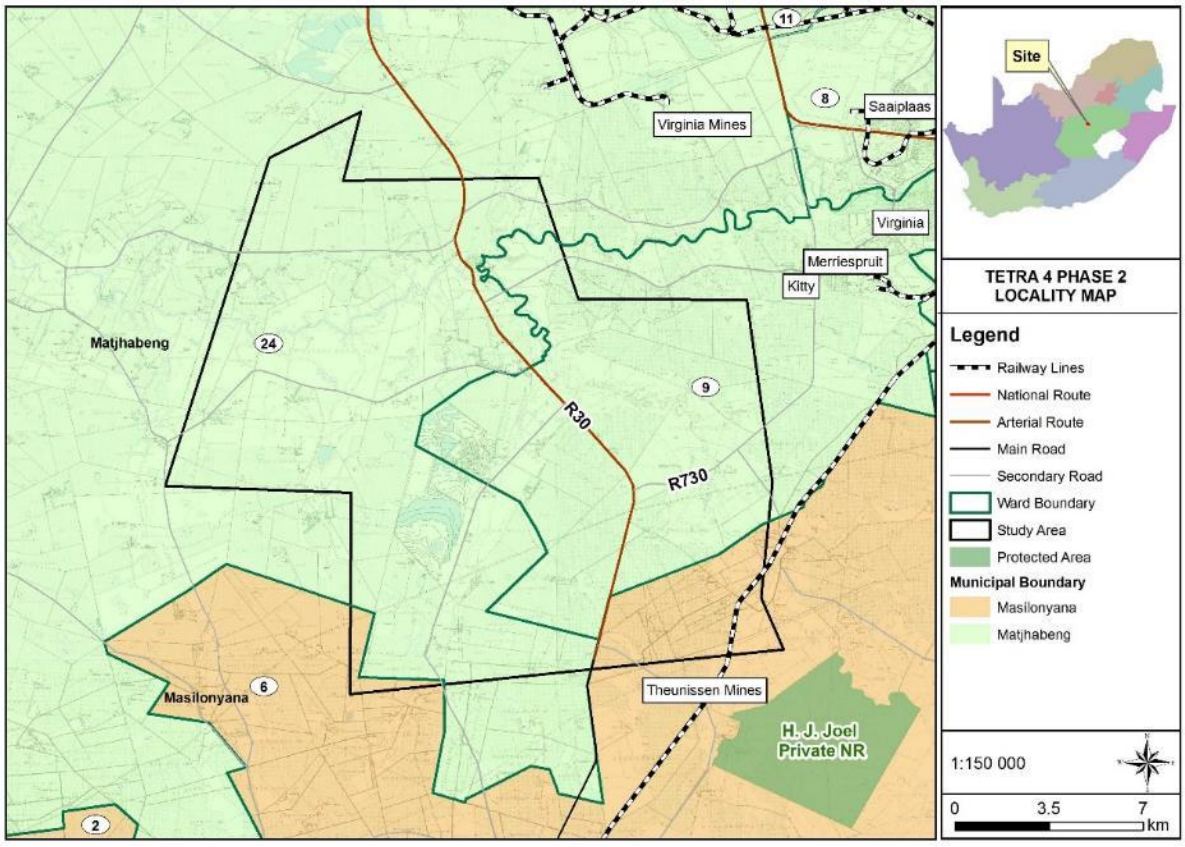


Figure 44: Location of the proposed Cluster 2 Project in relation to Municipal Wards.

8.3.2 LEJWELEPUTSWA DISTRICT MUNICIPALITY

The Lejweleputswa District Municipality (LDM) is situated in the north western part of the Free State and borders the North West Province to the north; the Fezile Dabi and Thabo Mofutsanyane District Municipalities to the north-east and east respectively; the Xhariep District Municipality and Mangaung Metropolitan Municipality to the south; and the Northern Cape Province to the west. The LDM is accessible from Johannesburg, Cape Town, Klerksdorp and Kimberley through one of South Africa's main national roads, the N1. The district covers an area of 32 286 km^2 and make up almost a third of the Free State province. It consists of the Masilonyana, Matjhabeng, Nala, Tokologo and Tswelopele Local Municipalities (www.lejweleputswa.co.za).

The economy of the district relies heavily on the gold mining sector which is dominant in the Matjhabeng and Masilonyana Local Municipalities (Lejweleputswa DM IDP 2021/22). The mining sector is on a downward trend and many businesses that have traditionally depended on the mining sector have either closed down are in the process of closing down. The other municipalities are dominated by agriculture.

8.3.3 MATJHABENG LOCAL MUNICIPALITY

The main towns in the Matjhabeng Local Municipality are Welkom, Odendaalsrus, Virginia, Hennenman, Allanridge and Ventersburg (www.matjhabeng.fs.gov.za). The economy of the municipality is centred on mining activities in and around Welkom, Allanridge, Odendaalsrus and Virginia. Manufacturing aimed at the mining sector exists to a limited extent in the aforementioned towns, with other activities being limited. Other main economic sectors include manufacturing, tourism, agriculture, gold jewellery, transportation (logistics), and retail (Matjhabeng LM IDP 2022/2023).

8.3.4 MASILONYANA LOCAL MUNICIPALITY

The main towns in the Masilonyana Local Municipality are Theunissen, Brandfort, Winburg, Verkeerdevlei and Soutpan (www.masilonyana.fs.gov.za). It is a semi-rural municipality that is dependent on agriculture and mining as the key drivers of its economy (Masilonyana LM IDP 2019/20). In 2016 the mining sector contributed about 52.4 % to the municipality's economic output, but only about 8 % of the employment in the municipality. With the decline in the mining sector the municipality plans to turn its focus on tourism. The municipality prides itself on its tourism destinations.

8.3.5 DESCRIPTION OF THE POPULATION

The baseline description of the population will take place on three levels, namely provincial, district and local. Impacts can only truly be comprehended by understanding the differences and similarities between the different levels. The baseline description will focus on the Matjhabeng Local Municipality and the Masilonyana Local Municipality in the Lejweleputswa District Municipality in the Free State Province (referred to in the text as the study area), as these are the areas that will be most affected by the proposed project. Where possible, the data will be reviewed on a ward level – Ward 9 and 24 of the Matjhabeng LM and Ward 6 of the Masilonyana LM. The data used for the socio-economic description was sourced from Census 2011. Census 2011 was a de facto census (a census in which people are enumerated according to where they stay on census night) where the reference night was 9-10 October 2011. The results should be viewed as indicative of the population characteristics in the area and should not be interpreted as absolute.

The following points regarding Census 2011 must be kept in mind (www.statssa.co.za):

- Comparisons of the results of labour market indicators in the post-apartheid population censuses over time have been a cause for concern. Improvements to key questions over the years mean that the labour market outcomes based on the post-apartheid censuses must be analysed with caution. The differences in the results over the years may be partly attributable to improvements in the questionnaire since 1996 rather than to actual developments in the labour market. The numbers published for the 1996, 2001, and 2011 censuses are therefore not comparable over time and are different from those published by Statistics South Africa in the surveys designed specifically for capturing official labour market results.

- For purposes of comparison over the period 1996–2011, certain categories of answers to questions in the censuses of 1996, 2001 and 2011, have either been merged or separated.
- The tenure status question for 1996 has been dropped since the question asked was totally unrelated to that asked thereafter. Comparisons for 2001 and 2011 do however remain.
- All household variables are controlled for housing units only and hence exclude all collective living arrangements as well as transient populations.
- When making comparisons of any indicator it must be considered that the time period between the first two censuses is five years and that between the second and third census is ten years. Although Census captures information at one given point in time, the period available for an indicator to change is different.

8.3.6 POPULATION AND HOUSEHOLD SIZES

According to the Community Survey 2016, the population of South Africa is approximately 55,7 million and has shown an increase of about 7.5 % since 2011. The household density for the country is estimated on approximately 3.29 people per household, indicating an average household size of 3-4 people (leaning towards 3) for most households, which is down from the 2011 average household size of 3.58 people per household. Smaller household sizes are in general associated with higher levels of urbanisation.

The greatest increase in population since 2011 has been on local level (Table 38), but still lower than the national average. Population density refers to the number of people per square kilometre and the population density on a national level has increased from 42.45 people per km^2 in 2011 to 45.63 people per km^2 in 2016. In the study area the population density has increased since 2011 with the highest density in the Matjabeng LM.

Table 38: Population density and growth estimates (sources: Census 2011, Community Survey 2016).

Area	Size in km^2	Population 2011	Population 2016	Population density 2011	Population density 2016	Growth in population (%)
Free State Province	129,825	2,745,590	2,834,714	21.15	21.83	3.25
Lejweleputswa DM	31,930	627,626	649,964	19.66	20.36	3.56
Matjhabeng LM	5,155	406,461	428,843	78.85	83.19	5.51
Masilonyana LM	6,796	63,334	66,084	9.32	9.72	4.34

The number of households in the study area has increased on all levels (Table 39). The proportionate increase in households were greater than the increase in population on all levels and exceeded the growth in households of 12.3 % on a national level. The average household size has shown a decrease on all levels, which means there are more households, but with less members.

Table 39: Household sizes and growth estimates (sources: Census 2011, Community Survey 2016).

Area	Households 2011	Households 2016	Average household size 2011	Average household size 2016	Growth in households (%)
Free State Province	823,316	946,639	3.33	2.99	14.98

Area	Households 2011	Households 2016	Average household size 2011	Average household size 2016	Growth in households (%)
Lejweleputswa DM	183,163	219,014	3.43	2.97	19.57
Matjhabeng LM	123,195	149,021	3.30	2.88	20.96
Masilonyana LM	17,575	22,802	3.60	2.90	29.74

The total dependency ratio is used to measure the pressure on the productive population and refer to the proportion of dependents per 100 working-age population. As the ratio increases, there may be an increased burden on the productive part of the population to maintain the upbringing and pensions of the economically dependent. A high dependency ratio can cause serious problems for a country as the largest proportion of a government's expenditure is on health, social grants and education that are most used by the old and young population.

The total dependency ratio in the Masilonyana LM is higher than on district or provincial level (Table 40), while in the Matjhaneng LM the total dependency ratio is lower that on district or provincial level. The same trend applies to the youth, aged and employment dependency ratios. Employed dependency ratio refers to the proportion of people dependent on the people who are employed, and not only those of working age. The employed dependency ratio for the Matjhabeng LM is lower than on district and provincial level, while for the Masilonyana LM it is higher. This suggests high levels of poverty in the Masilonyana area.

Table 40: Dependency ratios (source: Census 2011).

Area	Total dependency	Youth dependency	Aged dependency	Employed dependency
Free State Province	52.88	44.48	8.39	76.34
Lejweleputswa DM	51.33	43.71	7.61	77.16
Matjhabeng LM	46.93	40.09	6.85	75.46
Ward 9	31.92	24.88	7.04	68.37
Ward 24	31.54	29.01	2.53	69.84
Masilonyana LM	54.99	45.99	9.00	82.14
Ward 6	40.36	33.35	7.01	88.18

Poverty is a complex issue that manifests itself in economic, social and political ways. To define poverty by a unidimensional measure such as income or expenditure would be an oversimplification of the matter. Poor people themselves describe their experience of poverty as multidimensional. The South African Multidimensional Poverty Index (SAMPI) (Statistics South Africa, 2014) assess poverty on the dimensions of health, education, standard of living and economic activity using the indicators child mortality, years of schooling, school attendance, fuel for heating, lighting and cooking, water access, sanitation, dwelling type, asset ownership and unemployment.

The poverty headcount refers to the proportion of households that can be defined as multi-dimensionally poor by using the SAMPI's poverty cut-offs (Statistics South Africa, 2014). The poverty headcount has increased on all levels since 2011 (Table 41), indicating an increase in the number of multi-dimensionally poor households.

The intensity of poverty experienced refers to the average proportion of indicators in which poor households are deprived (Statistics South Africa, 2014). The intensity of poverty has increased slightly on all levels. The

intensity of poverty and the poverty headcount is used to calculate the SAMPI score. A higher score indicates a very poor community that is deprived on many indicators. The SAMPI score has increased in the Masilonyana LM area, indicating that households in this area might be getting poorer. In the Matjhabeng LM area the SAMPI score has decreased, suggesting an improvement in some respects relating to poverty in this area.

Table 41: Poverty and SAMPI scores (sources: Census 2011 and Community Survey 2016).

Area	Poverty headcount 2011 (%)	Poverty intensity 2011 (%)	SAMPI 2011	Poverty headcount 2016 (%)	Poverty intensity 2016 (%)	SAMPI 2016
Free State Province	5.5	42.2	0.023	5.5	41.7	0.023
Lejweleputswa DM	5.6	42.8	0.024	4.8	42.2	0.020
Matjhabeng LM	5.5	43.0	0.024	4.3	41.8	0.018
Masilonyana LM	5.3	41.8	0.022	6.5	41.8	0.027

8.3.7 POPULATION COMPOSITION, AGE, GENDER AND HOME LANGUAGE

In all the areas under investigation, the majority of the population belongs to the Black population group (Figure 45), but the proportions differ. Ward 24 has the highest proportion of people belonging to the Black population group, while Ward 9 has the highest proportion of people belonging to the White population group.

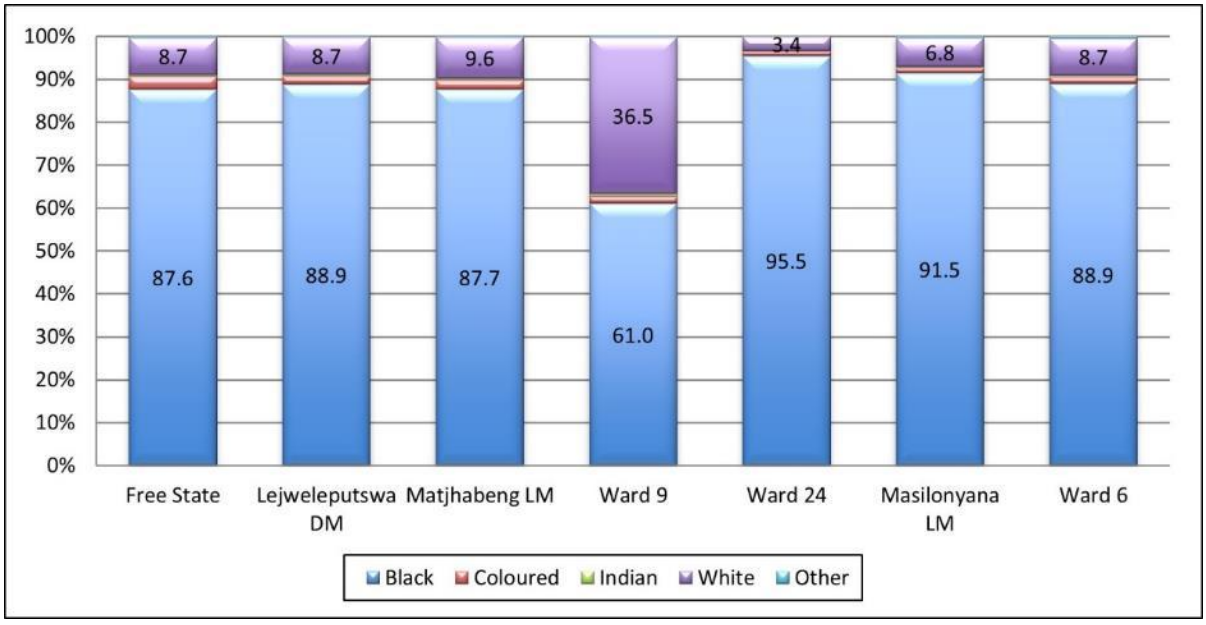


Figure 45: Population distribution (shown in percentage, source: Census 2011).

The average age on local level is higher than on district and provincial level (Table 42). The highest average age is in Ward 9 of the Matjhabeng LM.

Table 42: Average age (source: Census 2011).

Area	Average Age (in years)
Free State Province	28.38
Lejweleputswa DM	28.52

Area	Average Age (in years)
Matjhabeng LM	28.89
Ward 9	32.84
Ward 24	30.46
Masilonyana LM	28.73
Ward 6	31.21

The age distribution of the areas under investigation shows that the population in on a ward level tend to be older than on district or provincial level, with a greater proportion of people aged between 35 years to 64 years (Figure 46).

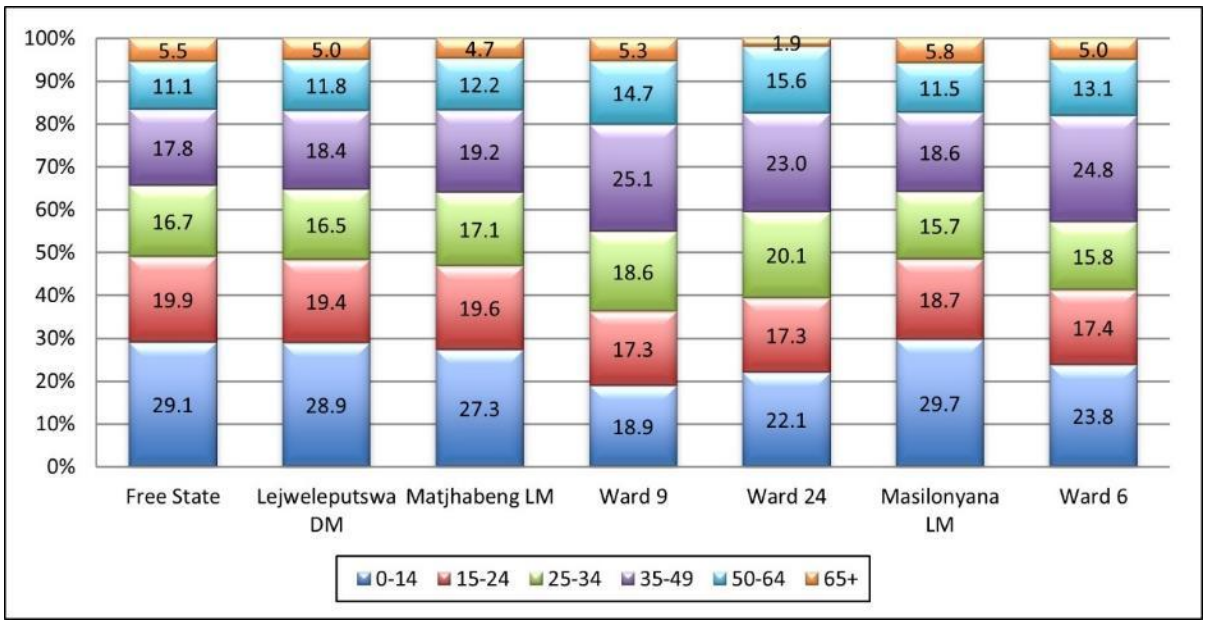


Figure 46: Age distribution (shown in percentage, source: Census 2011).

8.3.8 GENDER

The gender distribution on provincial, district and local level is balanced (Figure 47), but on a ward level there is a bias towards males. A higher incidence of males is usually found in mining areas and all three the wards have mining areas that appear to have residences for mine workers.

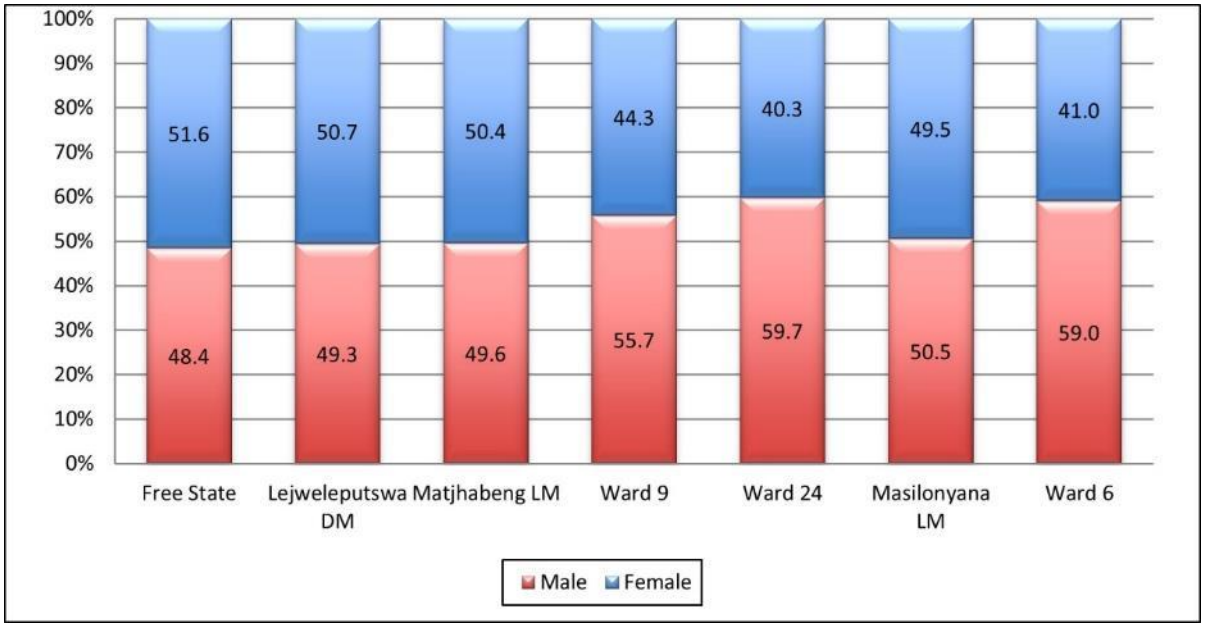


Figure 47: Gender distribution (shown in percentage, source: Census 2011).

8.3.9 LANGUAGE

Almost two thirds of people in the region have Sesotho as home language (Figure 48), except in Ward 9 where it is only about a third of people. In Ward 9 more than 40% of people have Afrikaans as home language. Almost a fifth of people in Ward 24 has IsiXhosa as home language, suggesting a high incidence of migrant mine workers residing in this ward. Based on the predominant languages in the area, the notifications for this application have been distributed in English, Afrikaans and Sesotho.

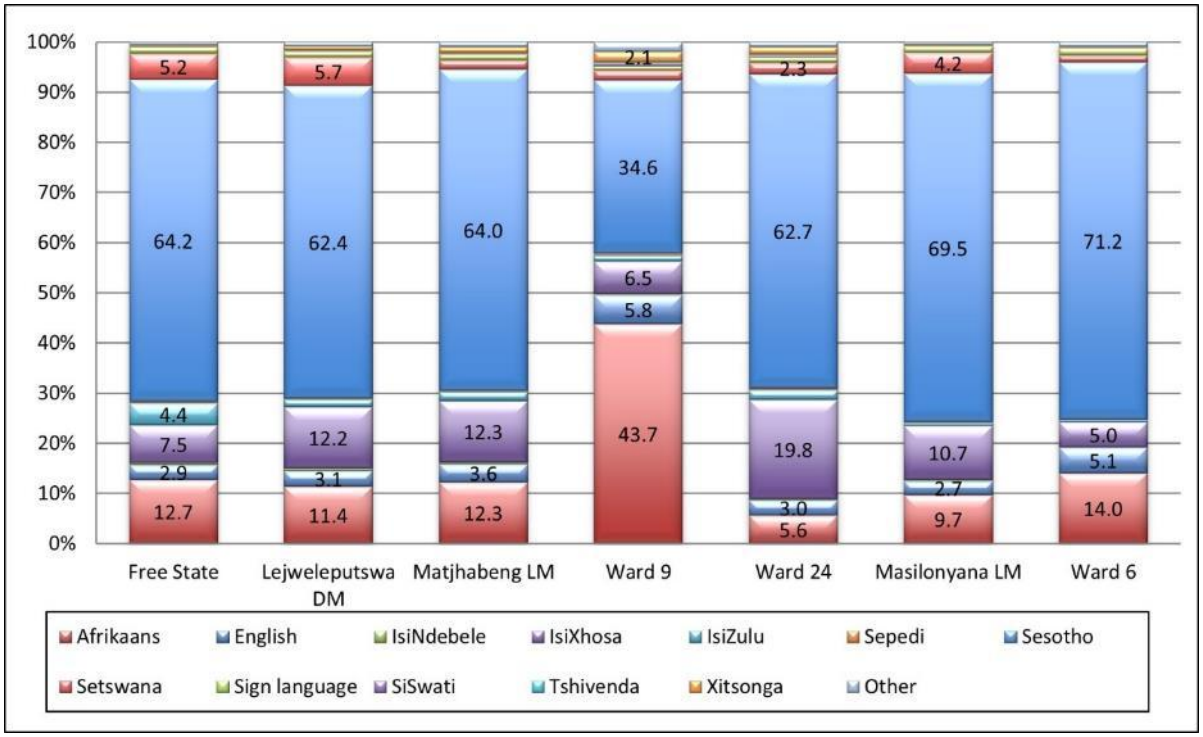


Figure 48: Language distribution (shown in percentage, source: Census 2011).

8.3.10 EDUCATION

Figure 49 shows the education profiles for the areas under investigation for those aged 20 years or older. Ward 9 has the highest proportion of people who have completed Grade 12 or higher, while more than 70 % of people in Wards 6 and 24 have not completed secondary school.

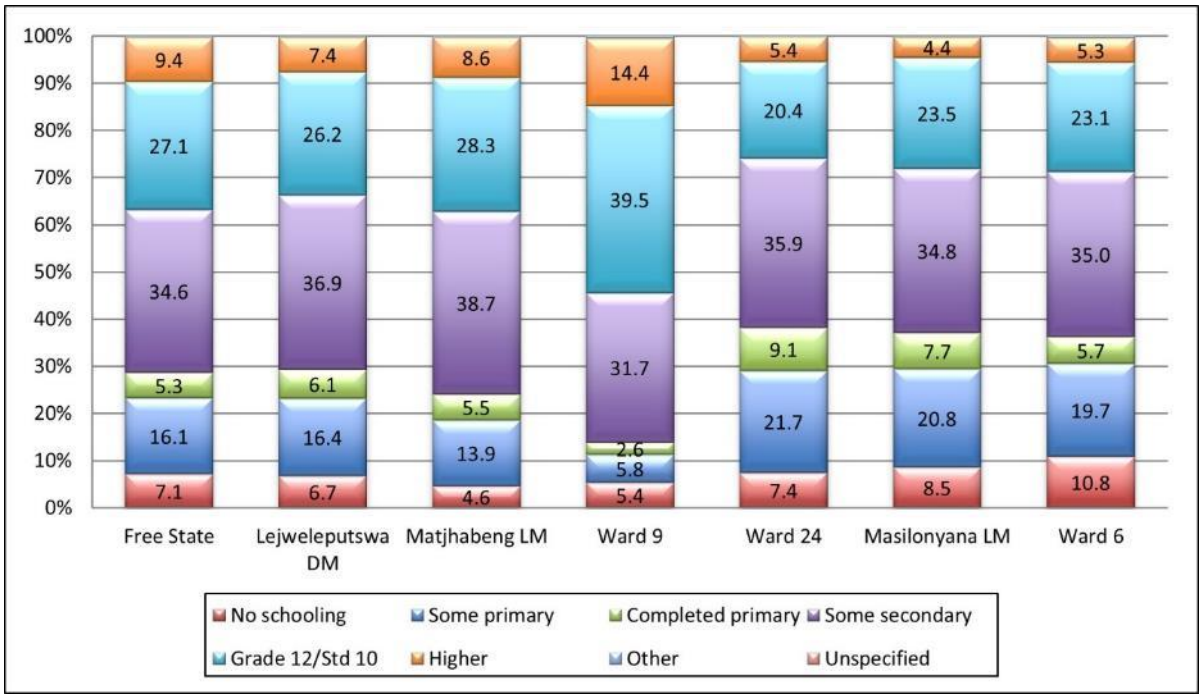


Figure 49: Education profiles (those aged 20 years or older, shown in percentage, source: Census 2011).

8.3.11 EMPLOYMENT

Ward 6 has the lowest proportion of people of economically active age (aged between 15 years and 65 years) that are employed (Figure 50), while Wards 9 and 24 have the highest proportions. Since 2010 employment in the gold mining industry showed a steady decline from 157 019 in 2010 to 94 399 in 2020 (www.mineralscouncil.org.za). As such the proportion unemployed people in the area are likely to have increased since 2011.

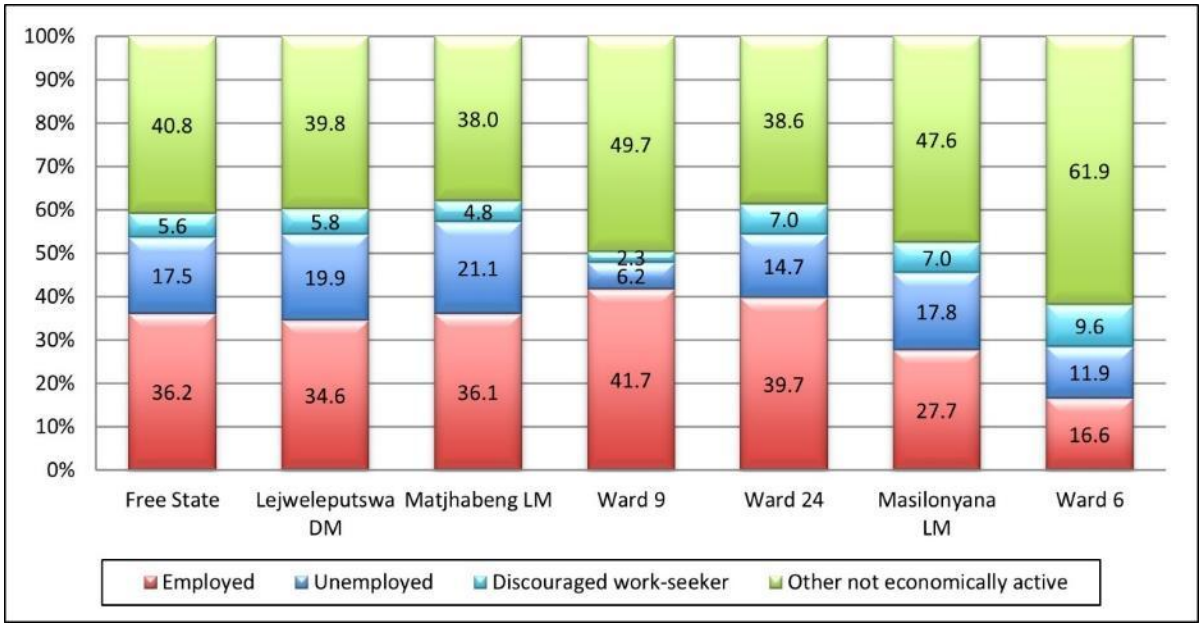


Figure 50: Labour status (those aged between 15 - 65 years, shown in percentage, source: Census 2011).

Most of the employed people in the areas under investigation work in the formal sector (Figure 51). Ward 9 has the highest proportion of people working in the formal sector while Ward 6 has the highest proportion of people working for private households.

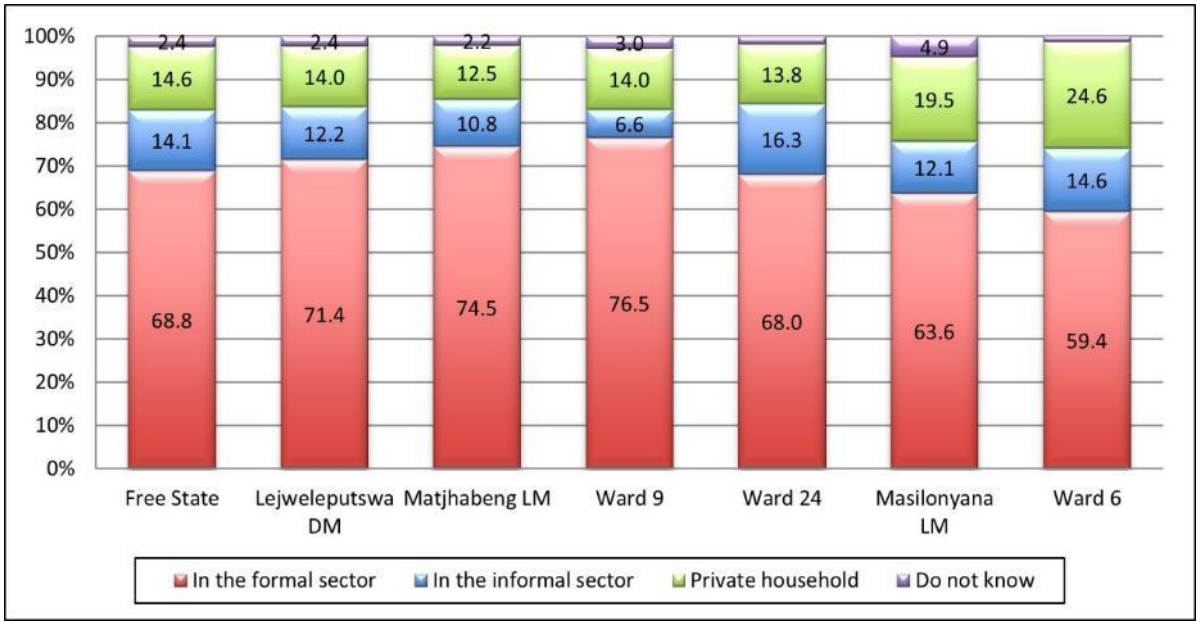


Figure 51: Employment sector (those aged between 15 - 65 years, shown in percentage, source: Census 2011).

8.3.12 HOUSEHOLD INCOME

Ward 24 has the highest proportion of households that have no annual household income (Figure 52), while Ward 9 has the highest average household income.

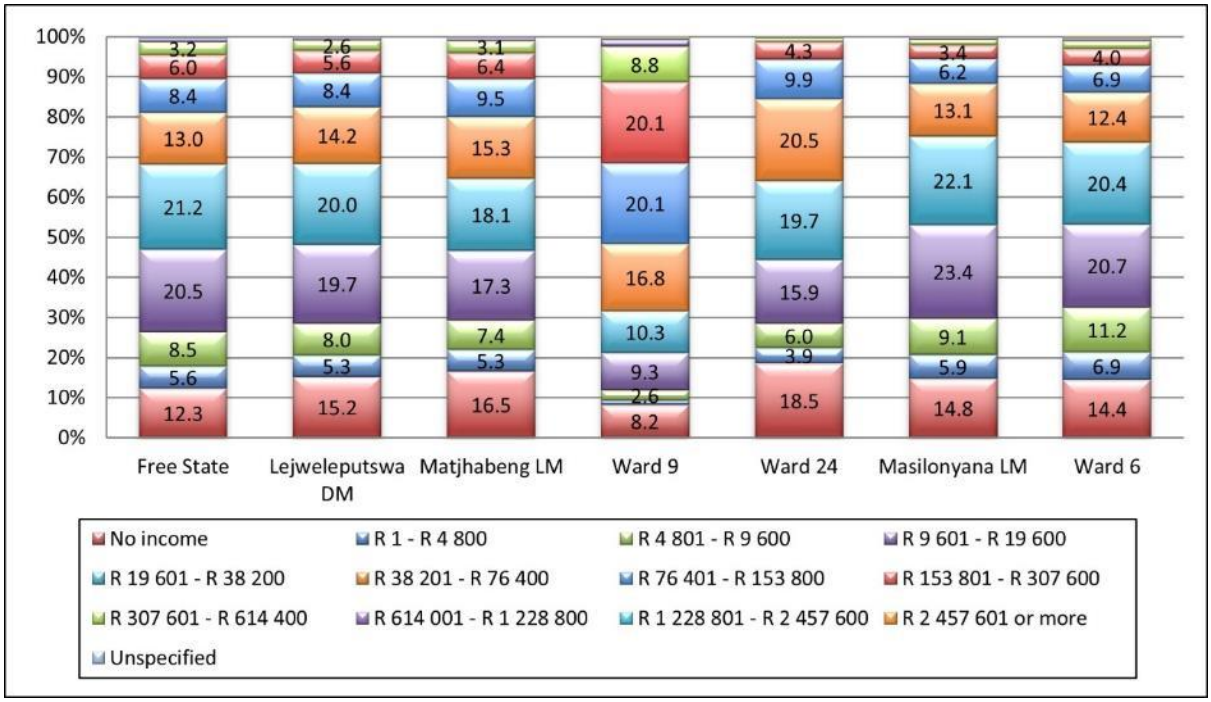


Figure 52: Annual household income (shown in percentage, source: Census 2011).

8.3.13 HOUSING

On a ward level most households live in areas classified as urban. Wards 24 and 6 have the highest incidence of households living on farms. In Ward 24 almost a quarter of households live on farms. Ward 9 includes a large portion of the town of Virginia.

Table 43: Geotypes (source: Census 2011, households).

Area	Urban	Tribal/Traditional	Farm
Free State Province	84.5	8.8	6.7
Lejweleputswa DM	93.9	0.0	6.1
Matjhabeng LM	97.7	0.0	2.3
Ward 9	94.2	0.0	5.8
Ward 24	75.2	0.0	24.8
Masilonyana LM	91.4	0.0	8.6
Ward 6	87.4	0.0	12.6

Most households live in formal residential areas (Figure 53), with about a quarter of households in Ward 6 and a third of households in Ward 24 residing in collective living quarters. Just over a quarter of households in Ward 24 live in informal residential areas.

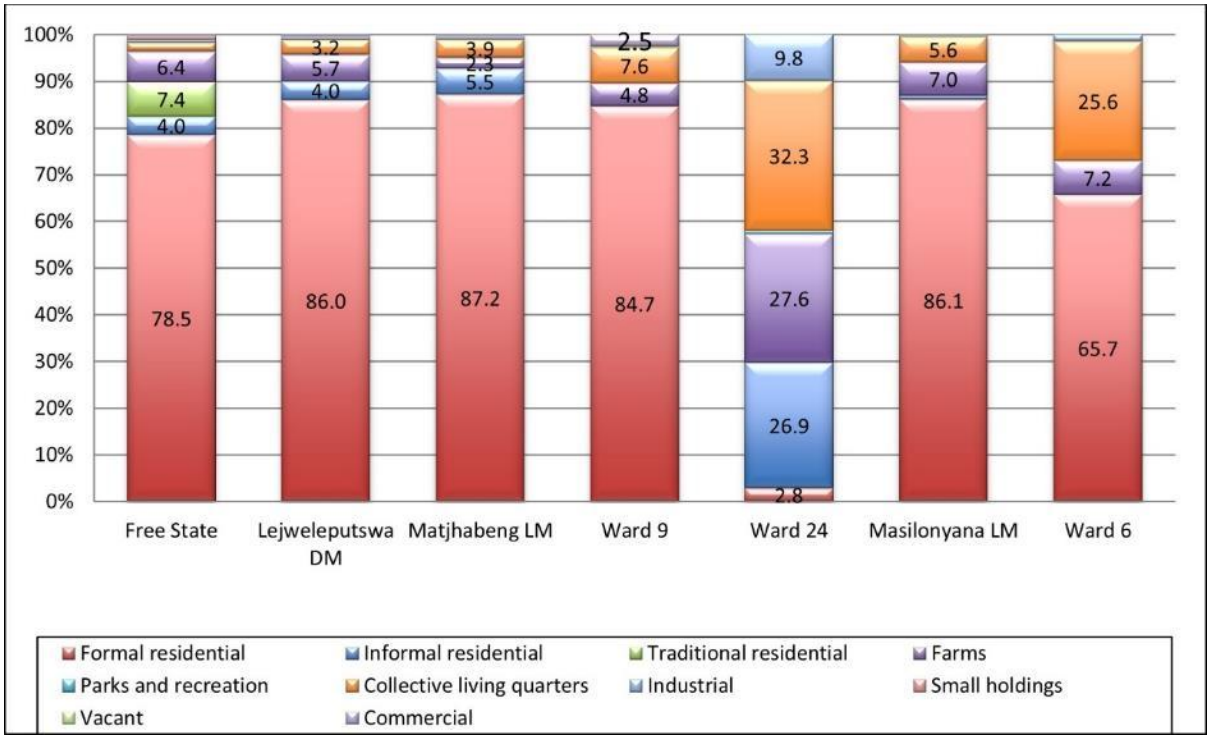


Figure 53: Enumeration area types (persons, shown in percentage, source: Census 2011).

Most of the dwellings in the area are houses or brick/concrete block structures that are on a separate yard, stand or farm (Figure 54), except in Ward 24 where about a third of the dwellings are informal and a fifth live in a flat or an apartment in a block of flats.

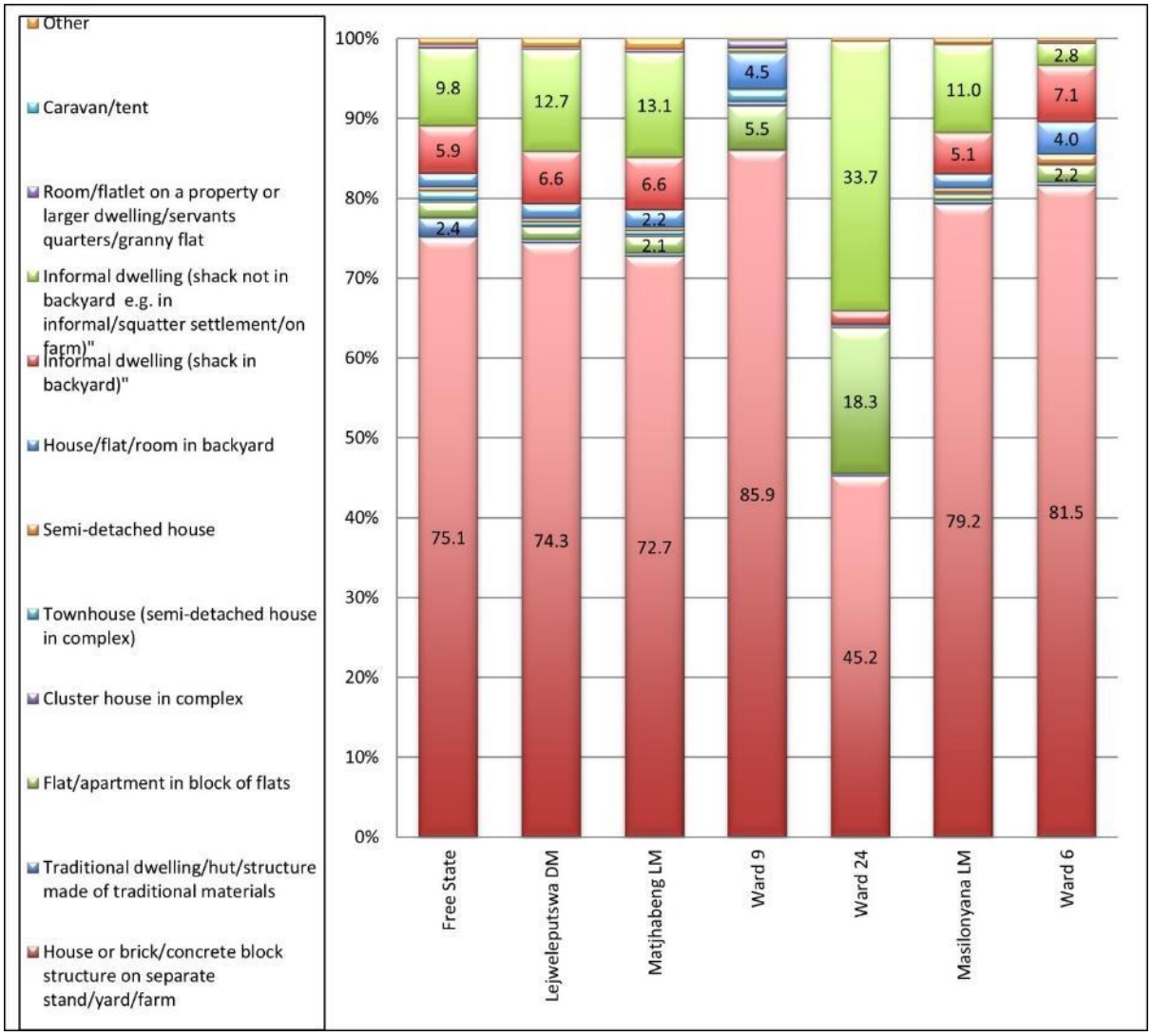


Figure 54: Dwelling types (shown in percentage, source: Census 2011).

Ward 24 has the largest proportion of households that are renting their dwellings (Figure 55), with more than half of the households renting, while Ward 6 has the largest proportion of households that own their dwellings and have paid them off in full.

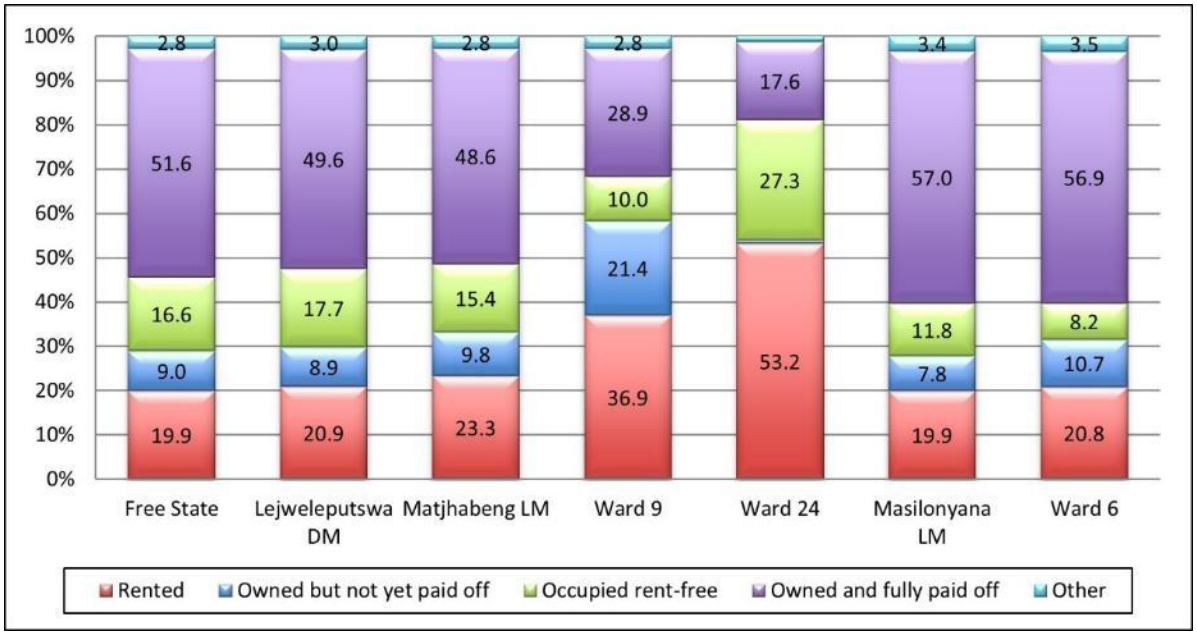


Figure 55: Tenure status (shown in percentage, source: Census 2011).

8.3.14 HOUSEHOLD SIZE

Household sizes on a ward level in the Matjhabeng LM tend to be smaller than on local, district or provincial level (Figure 56), with approximately 50 % or more of households on ward level consisting of one or two people, compared to just over 40 % on local, district and provincial level. In Ward 6 of the Masilonyana LM households' sizes tend to be larger than on local, district or provincial level.

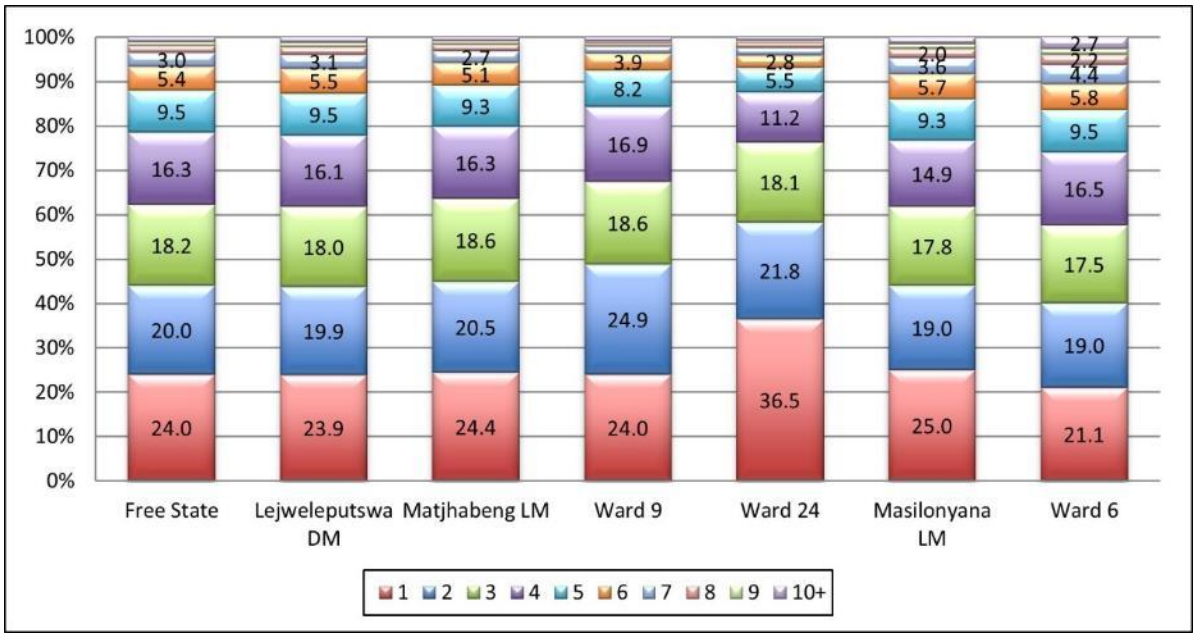


Figure 56: Household size (shown in percentage, source: Census 2011).

8.3.15 ACCESS TO WATER AND SANITATION

Ward 24 has the lowest incidence of households that access to water from a local or a regional water scheme, but the highest incidence of households that get their water from a borehole or another source (Figure 57).

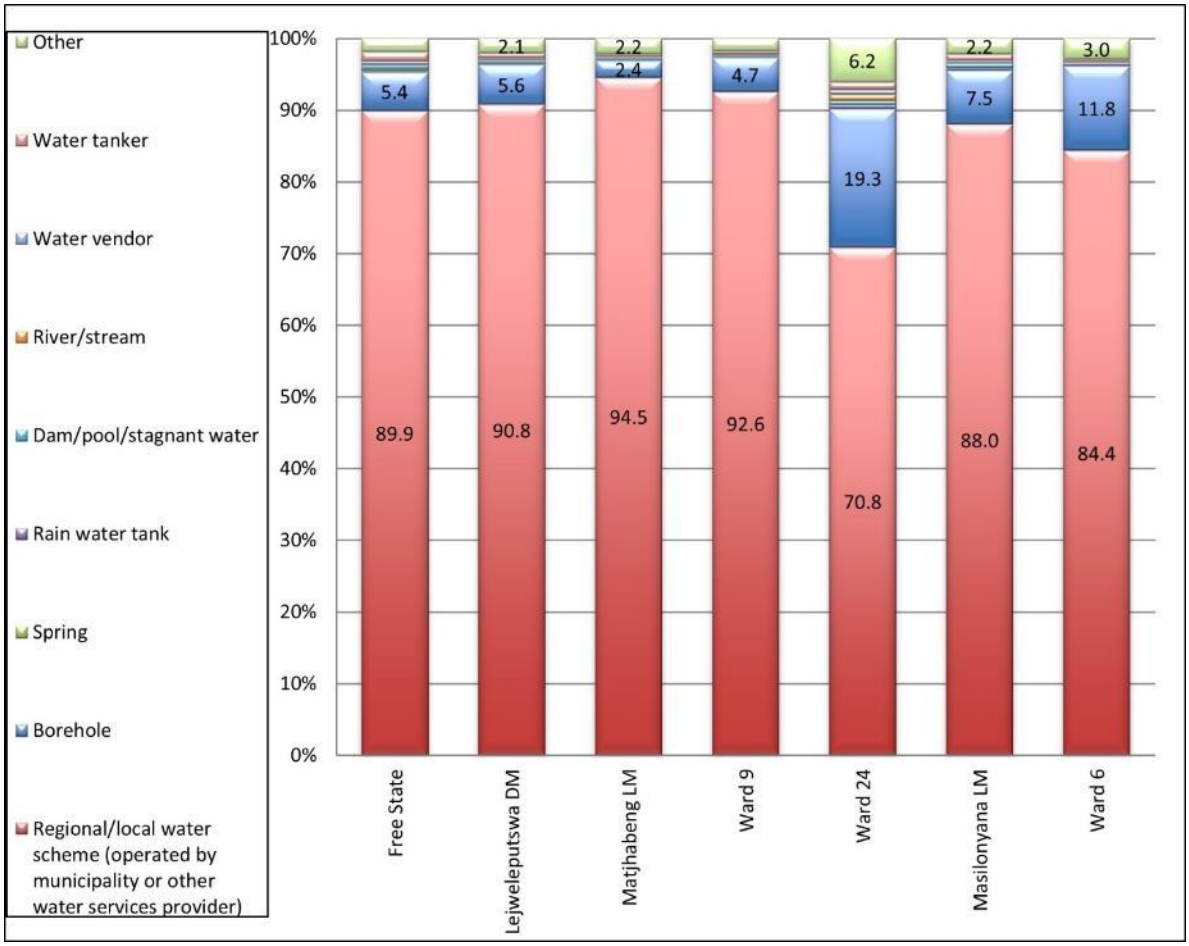


Figure 57: Water source (shown in percentage, source: Census 2011).

Access to piped water, electricity and sanitation relate to the domain of Living Environment Deprivation as identified by Noble et al (2006). Almost 90 % of households in Ward 9 has access to piped water inside the dwelling (Figure 58). In Ward 6 more than 90 % of households have access to water insider their dwelling or stand, compared to almost 80 % in Ward 24.

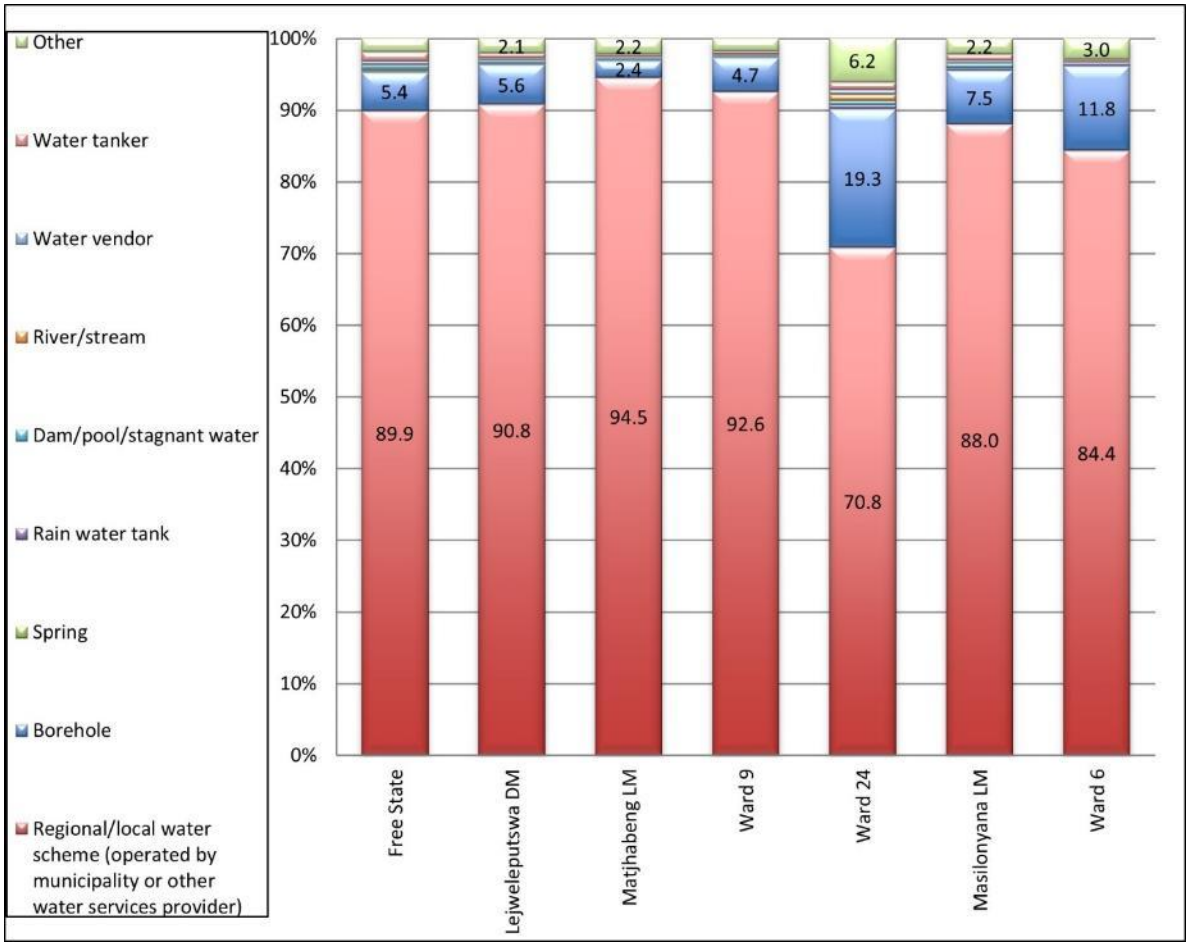


Figure 58: Piped water (shown in percentage, source: Census 2011).

The highest incidence of households that do not have access to any sanitation services is in Ward 24 (Figure 59), with approximately a third of the households in the ward having access to pit toilets without ventilation.

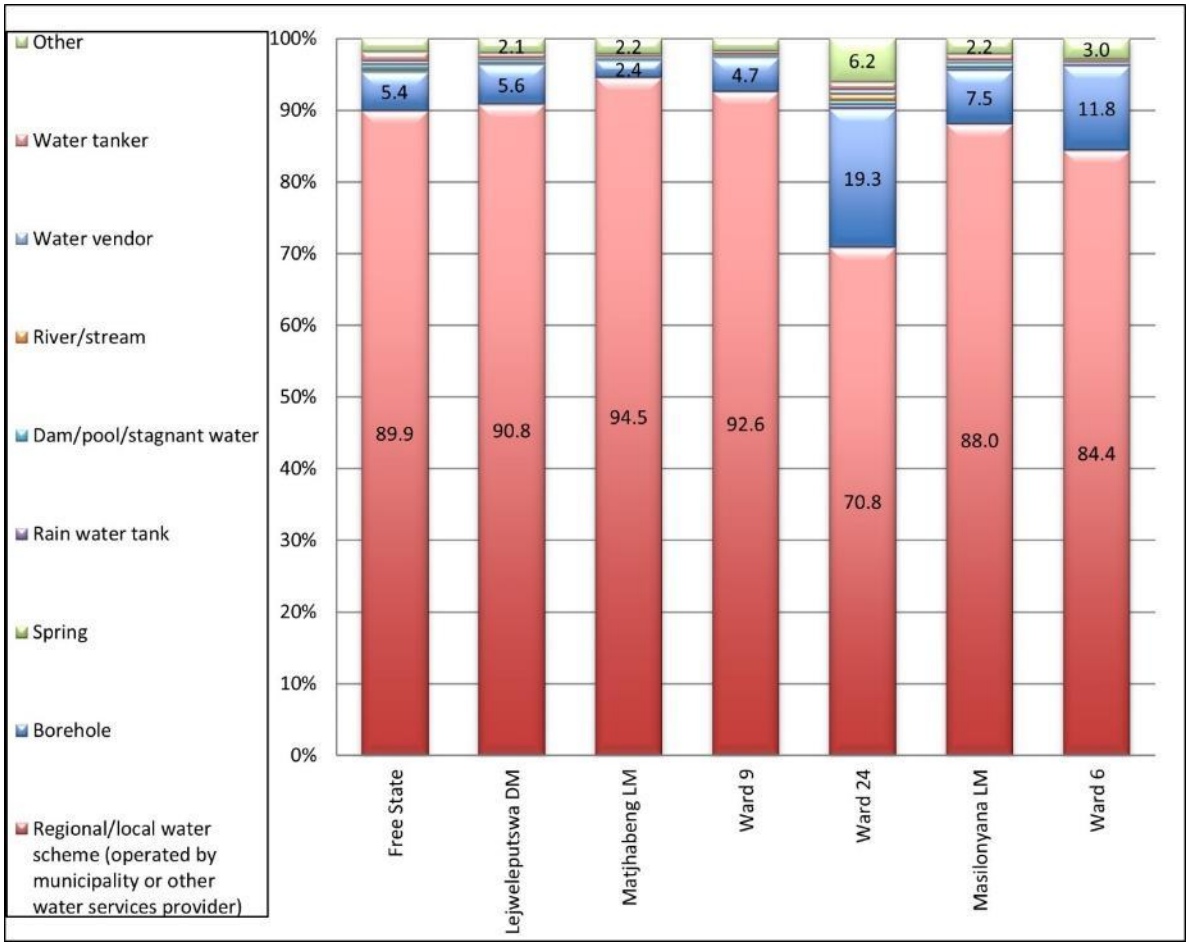


Figure 59: Sanitation (shown in percentage, source: Census 2011).

8.3.16 ENERGY

Electricity is seen as the preferred lighting source (Noble et al, 2006) and the lack thereof should thus be considered a deprivation. Even though electricity as an energy source may be available, the choice of energy for cooking may be dependent on other factors such as cost. More than 80 % of households have access to electricity as energy source for lighting (Figure 60), with candles the second most used source.

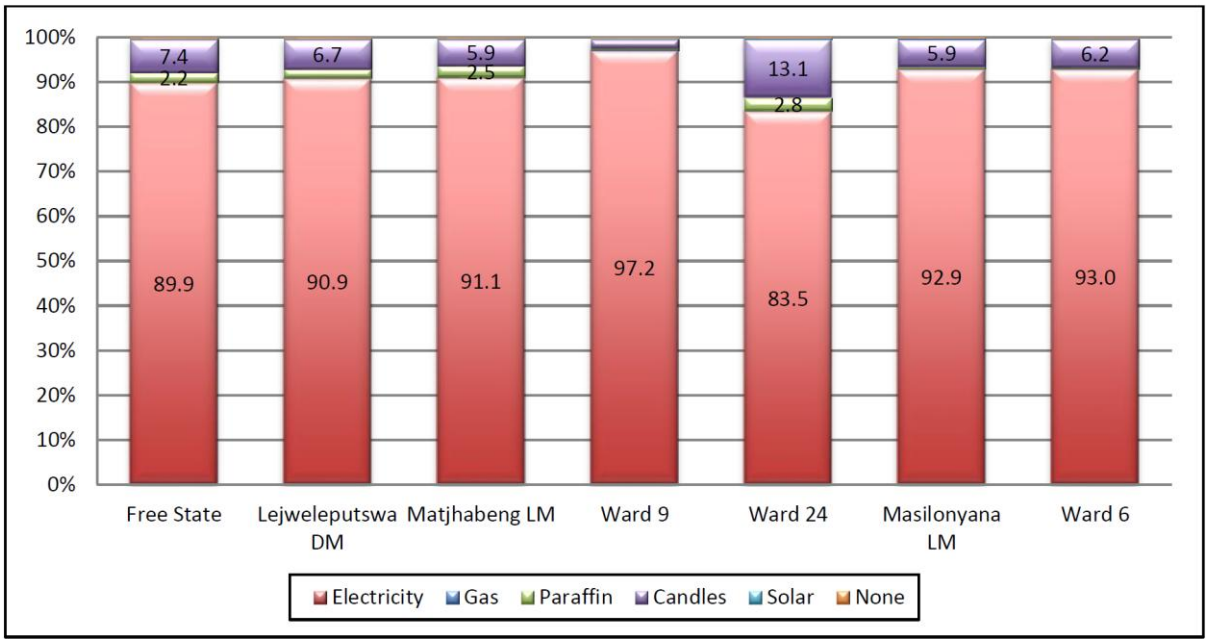


Figure 60: Energy source for lighting (shown in percentage, source: Census 2011).

8.3.17 REFUSE REMOVAL

Wards 6 and 24 have the lowest incidence of households that have their refuse removed at least once a week by a local authority or private company (Figure 61), with almost a third of households in Ward 24 having no rubbish disposal.

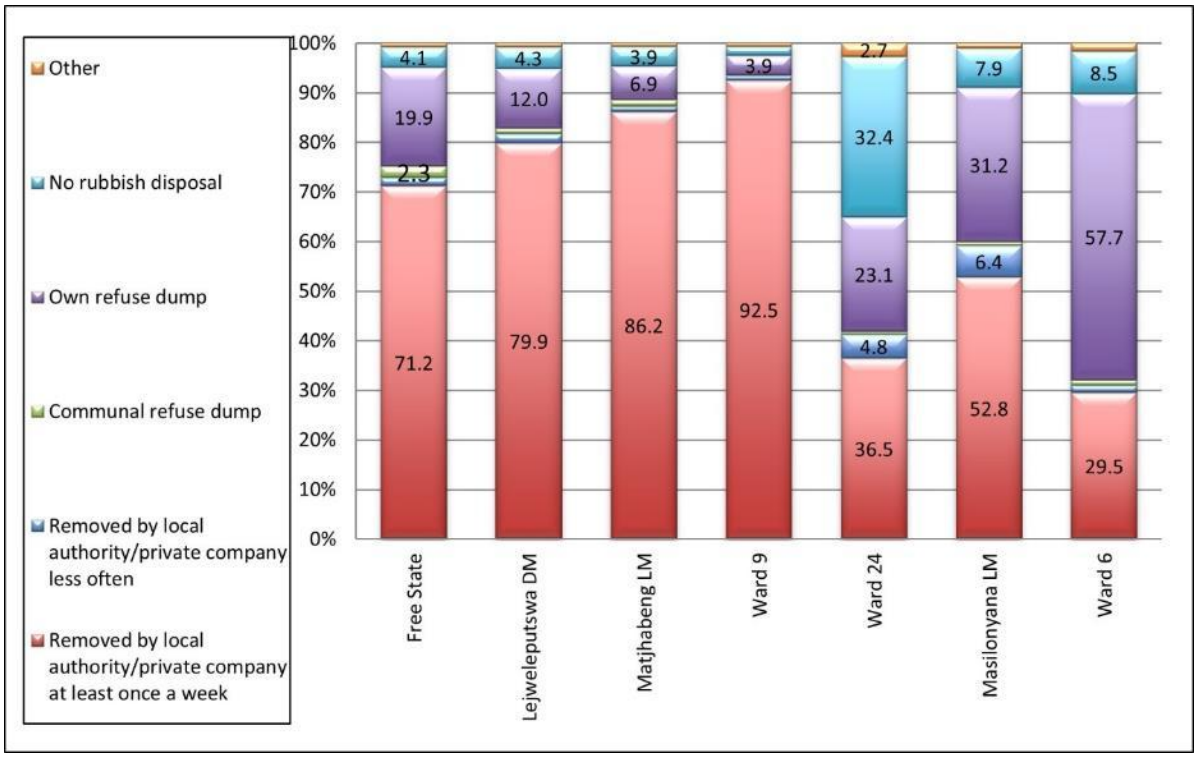


Figure 61: Refuse removal (shown in percentage, source: Census 2011).

8.4 CULTURAL HERITAGE

Table 44 provides a high-level summary of the archaeological and historical events within the project area and surroundings. A detailed overview can be found in the Heritage Impact Assessment Report (Appendix E).

Table 44: Summary of archaeological and historical events.

Stone Age 2.5 million years ago to c. 1800s	Iron Age AD 1700 to 1820s	The Early Colonial Period 1804 to 1843	Mid to Late Nineteenth Century 1848 to 1899	The South African War 1899 to 1902	Early Twentieth Century 1902 to 1913	Boer Rebellion 1914 to 1918	Remainder of the Twentieth Century 1915 to Present Day
The Earlier Stone Age (ESA) represents South Africa's oldest archaeological period, consisting of two phases: the Oldowan (~2 million years ago, characterized by crude tools) and the Acheulian (~1.5 million years ago, known for more refined stone tools). Importantly for this assessment, no evidence of ESA sites has been recorded within or surrounding the study area The Middle Stone Age (MSA) is characterized by tools made using the prepared core technique—such as flakes, points, and blades—and is linked to the complex cognition of early modern humans. Locally, research by the National Museum in Bloemfontein has identified ten sites within the erosion gullies of the Sand, Vet, and Doring Rivers, where MSA and Later Stone Age (LSA) artifacts were discovered alongside mammal fossil remains. The Later Stone Age (LSA) is defined by the use of microlithic stone tools and the creation of rock art, and is historically associated with San hunter-gatherers and Khoekhoe pastoralists. While LSA artifacts have been found alongside MSA lithics along the Sand, Vet, and Doring Rivers, no other LSA sites or rock art locations are known to exist within or around the immediate study area	The arrival of early farming communities during the first millendium, heralded in the start of the Iron Age for South Africa. The Iron Age is that period in South Africa's archaeological history associated with pre-colonial farming communities associated with agricultural and pastoralsit farming activites, metal working, cultural customs such as lobola as well as the tangible representation of the significance of cattle imprinted on their settlement layouts (known as the Central Cattle Pattern) (Huffman, 2007). According to the distribution map for Iron Age settlements on the Southern Highveld as published in Maggs (1976), the study area is located to the west of the known distribution of such Late Iron Age sites. It is therefore unlikely for any Late Iron Age sites to be located within the study area or its immediate surroundings. This surmise is largely supported by the distribution maps as published by Huffman (2007), albeit these latter distribution maps (which are based on known archaeological information) indicate that the study area is located very close to the periphery of two Iron Age facies. For the sake of completeness, these two Iron Age facies, known as Thabeng and Makgwareng, will be presented here.	The early Colonial Period within the study area and surroundings was characterised by the arrival of newcomers to the Transoraniga. The first arrivals were the Griqua followed by white Trekboers, who for the most part practiced a nomadic pastoralist way of life and were small in number. During the 1830s a mass migration of roughly 2 540 Afrikaner families (comprising approximately 12 000 individuals) from the frontier zone of the Cape Colony to the interior of Southern Africa took place. The people who took part in this Great Trek were later to be known as Voortrekkers (Visagie, 2011).	The region's 19th-century landscape was heavily defined by the Mfecane migrations and Voortrekker settlements. These movements catalyzed major political shifts, culminating in the Sand River Convention and the establishment of the Orange Free State. By the late 1800s, the area rapidly industrialized. Expanding railways spurred the creation of towns like Ventersburg and Virginia, while early diamond and gold prospecting—including an 18-meter-deep shaft on the farm Aandenk—laid the foundation for the Free State Goldfields. These early mining operations were halted by the South African War, which left a major historical footprint on the area, most notably the 1900 Battle of Zand River across the Kalkoenkrans farm. Because these battlefields and archaeological sites are strictly protected under the National Heritage Resources Act, any proposed development in the area carries a high risk of impacting significant heritage resources.	The South African War was fought between the Boer Republics of the Transvaal and Free State on the one side and Great Britain on the other, but is referred to as the South African War as the victims and participants of the war were not excluded to Britain or Boer alone. As will be discussed in more detail below, the march of Lord Roberts from Bloemfontein to Pretoria in May and June 1900 was especially significant in terms of the study area. In particular, the so-called Battle of Zand River (7 – 10 May 1900) was fought very close to the study area, with at least the movement of troops during the battle taking place across the study area.	Following the South African War, diamond operations briefly resumed under the restructured New Driekopjes Diamond Mining Company. However, disappointing yields forced a permanent halt to operations at the Driekopjes and Welgegund sites by late 1904, resulting in the company's liquidation. Subsequent mining at the Welgegund site was taken over by the Magnus Diamond Syndicate and the Triumph Diamond Mining Company. In 1911, these claims were acquired and consolidated into the new Drie Koppie Diamond Mine Limited. While desktop records of its later history are scarce, physical field evidence indicates this mine operated into the relatively recent past. Gold prospecting also saw renewed efforts during this period. In 1904, prospector Archibald Megson arrived at the farm Aandenk and reopened the original 1890s trench. He excavated to a depth of 30 meters and successfully found indications of gold. Despite these promising samples, Megson failed to secure financial backing in Johannesburg, as investors were entirely focused on the booming Witwatersrand goldfields. Amidst these mining developments, local civic infrastructure continued to	At the end of the South African War (1899 – 1902), the Transvaal and Orange Free State republics lost their independence to the British Empire. In 1910, the Union of South Africa was established consisting of the Cape Colony, Natal, the Transvaal Colony and the Orange River Colony. General Louis Botha was appointed the Union's first prime minister and believed that South Africa's future would be best served as part of the British Commonwealth. In 1914, the South African government under General Louis Botha decided to assist Great Britain in its war with Germany. A number of Boer leaders were not happy about this turn of events, and when General Koos de la Rey was killed at a roadblock in Johannesburg, emotions reached a boiling point and rebellion broke out across the former Boer republics. This rebellion saw more than 11 000 Boer men under the leadership of some of the former Boer War generals such as De Wet, Maritz, Kemp and Beyers rebelling against the South African government and its armed forces under the leadership of former Boer War generals Louis Botha and Jan Smuts.	In 1929, prospector Archibald Megson partnered with Allan Roberts and Emmanuel Jacobson to form Wit. Extensions Limited, resuming exploration on the farm Aandenk. Despite drilling near Megson's original trench, the syndicate was forced to abandon the project in 1935 due to depleted funds. Tragically, they missed the gold-bearing reef by just 122 meters, costing them the discovery of the Free State goldfields and leaving them in poverty. The town of Allanridge was later named in Roberts' honor. Following these initial failures, the Anglo American Corporation acquired the prospecting rights in 1937, sparking widespread corporate interest in the region. The Free State gold rush officially began in 1939 when payable gold was finally discovered on the farms Uitsig (at a depth of 823 meters) and St. Helena (at 348 meters). In 1941, St. Helena received the region's first gold mining lease, which was quickly followed by the establishment of several other major mining companies. Excitement peaked in 1946 when the Blinkpoort Gold Syndicate struck an exceptionally rich reef at a depth of 1,195 meters. It yielded an astonishing 1,947 grams per tonne, nearly five times the national average of roughly 389 grams per tonne. This massive economic boom necessitated new urban centers. In 1947, Anglo

Stone Age	Iron Age	The Early Colonial Period	Mid to Late Nineteenth Century	The South African War	Early Twentieth Century	Boer Rebellion	Remainder of the Twentieth Century
2.5 million years ago to c. 1800s	AD 1700 to 1820s	1804 to 1843	1848 to 1899	1899 to 1902	1902 to 1913	1914 to 1918	1915 to Present Day
					grow. In 1907, following a petition by local farmers, the town of Theunissen was proclaimed near the Smaldeel railway siding. Named after the petition's leader, Commandant Helgaardt Theunissen, the town officially became a municipality in 1912.		American established Welkom as a uniquely designed garden city. Neighboring Odendaalsrus expanded rapidly, and the town of Virginia was officially laid out in 1954 as surrounding mines reached full production. Mining operations continued to evolve into the 1980s with the commissioning of the Beisa (uranium) and Beatrix (gold) shafts. Although fluctuating uranium prices forced Beisa's temporary closure, it was soon restructured, sinking new shafts and reopening as the Oryx Mine in 1987, alongside new exploration efforts on the farm Kalkoenkrans.

8.4.1 SITE SPECIFIC HERITAGE FEATURES

During the fieldwork a total of 22 heritage sites and 28 features were identified. These consist of six historical homesteads (T_BD_2, T_JR_1, T_JR_2, T_JR_3, T_VlkP_1, and T_WTD_1); five metal objects (T_VklP_1, T_VklP_4[a], T_VklP_6, T_VklP_7, and T_VklP_10); 12 recent structures (T_VklP_1[b], T_VklP_2, T_VklP_3, T_VklP_5, T_VklP_7[a], T_VklP_9, T_VklP_10[a], T_WTD_2, T_WTD_3, T_WTD_4, T_WTD_5, and T_WTD_6) , one ceramic surface scatter (T_BD_1); and one grave (T_BV_1). The heritage features can be seen in Figure 62, and close up in Figure 63 to Figure 65.

Historical Homesteads/Structures

Of the six historical homesteads/structures identified on site, (T_BD_2, T_JR_1, T_JR_2, T_JR_3, T_VlkP_1, and T_WTD_1); all were predominantly foundation remnants or had >5% ex situ[1]. All were graded as NCW with zero-low local significance.

Recent Structures

12 recent structures were identified on site, all were predominantly foundation remnants or had >5% ex situ (T_VklP_1[b], T_VklP_2, T_VklP_3, T_VklP_5, T_VklP_7[a], T_VklP_9, T_VklP_10[a], T_WTD_2, T_WTD_3, T_WTD_4, T_WTD_5, and T_WTD_6); all of which were graded as NCW with zero local significance.

Archaeological/Historical Material

There were five metal objects (T_VklP_1, T_VklP_4[a], T_VklP_6, T_VklP_7, and T_VklP_10), graded NCW with low local significance, and one ceramic surface scatter (T_BD_1) of famille-bleu polychrome ceramic sherds, graded NCW with low local significance.

Burial Grounds and Graves

A single illegibly marked grave was identified (T_BV_1), and graded as Grade IIIA, with high significance. It should be noted that the landowner advised of another grave within the vicinity, but was not forthcoming with a precise bearing, and the receiving environment was incredibly overgrown and impassable.

[1] More than 5% of the heritage features not in the original location (in situ).

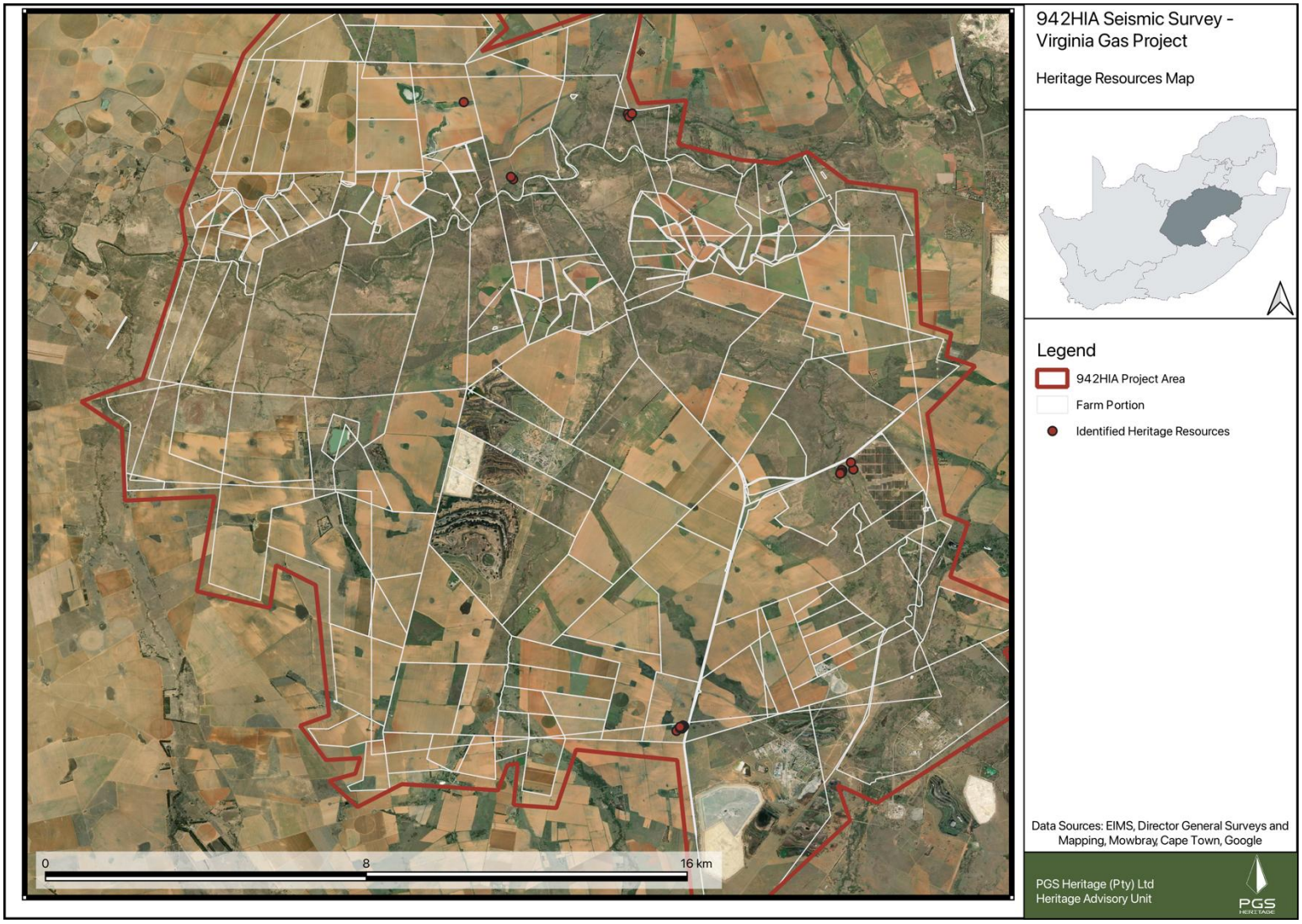


Figure 62: Identified heritage resources in project area.

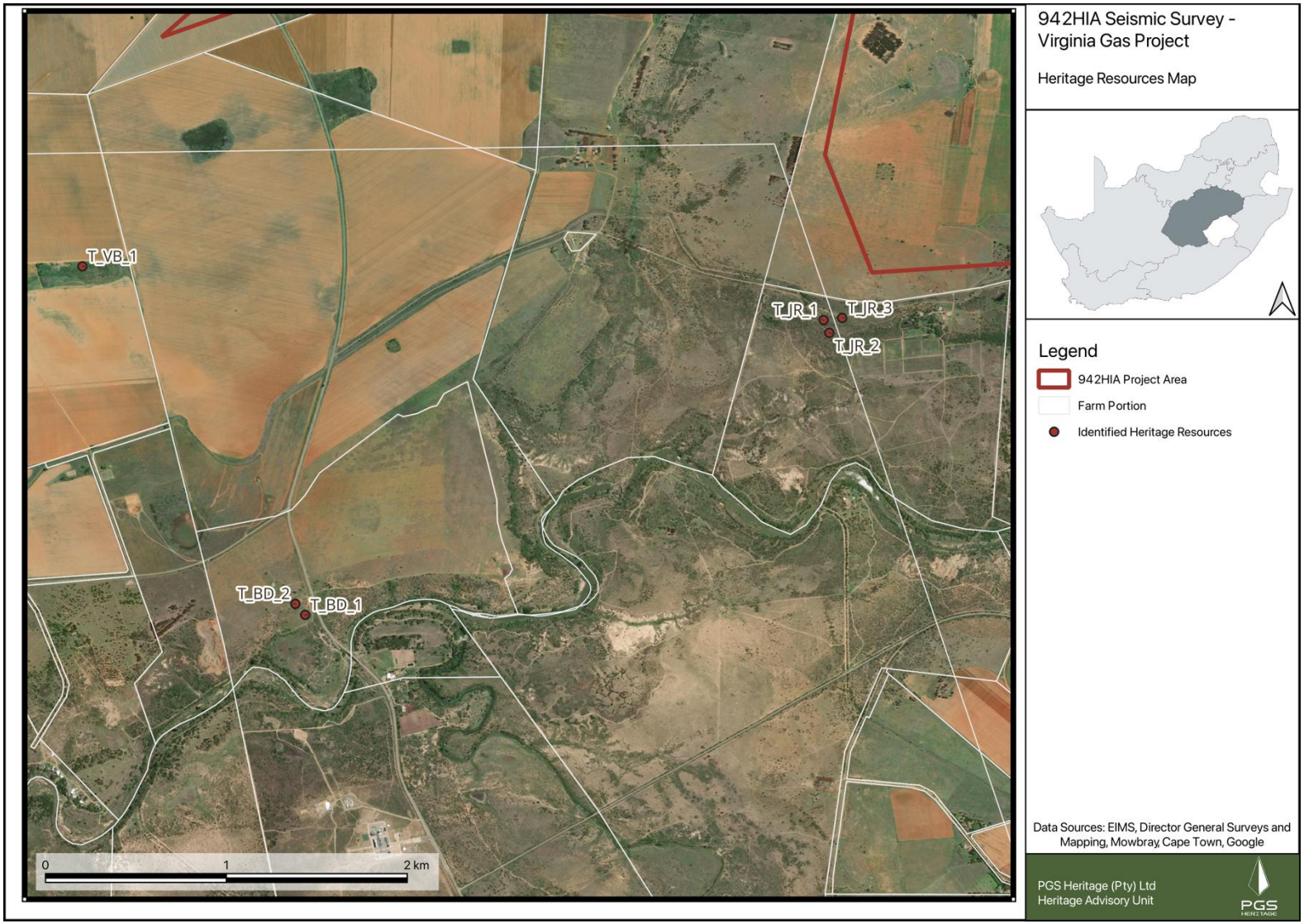


Figure 63: Identified heritage resources, as recorded on the Farms Vaalbank 190, Blaauwdrift 188 and Jonkers Rust 72.

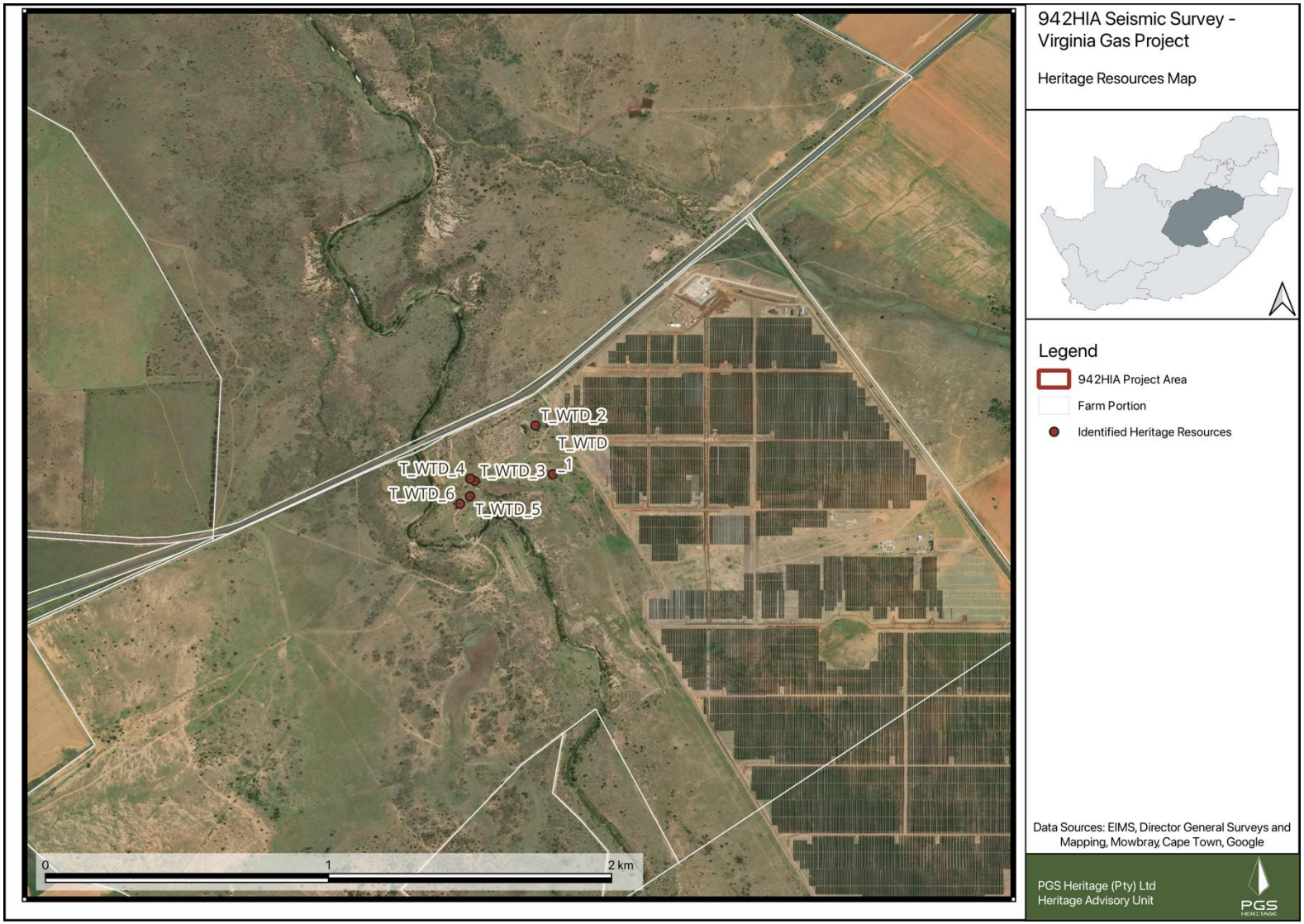


Figure 64: Identified heritage resources, as recorded on the Farm Weltevrede 638.

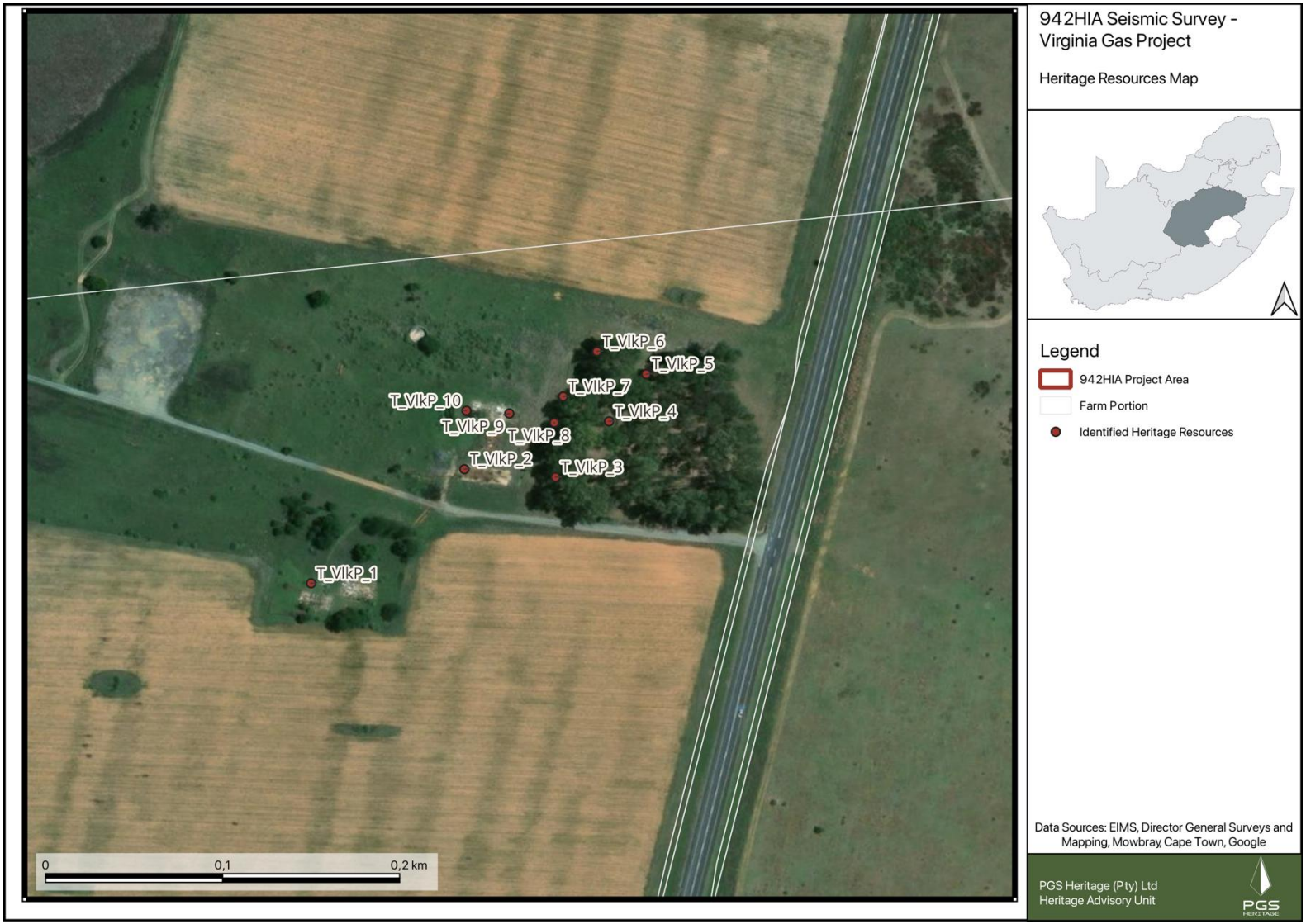


Figure 65: Identified heritage resources, as recorded on the Farm Vlakpan 358.

8.5 ECONOMIC ENVIRONMENT

An economic impact assessment has been conducted by Strategy4Good as part of the Tetra4 Cluster 2 EIA . The sub-sections below provide an overview of the economic baseline applicable to this project. As the majority of the study area falls within the Matjhabeng Local Municipality which is also a significantly larger municipality than the Masilonyana Local Municipality, the economic impacts of the project have been compared to the Matjhabeng Local Municipality.

8.5.1 NATIONAL ECONOMY

In the broader receiving environment, the national economy is under much stress and in a receiving environment of this nature it would be commonplace to observe that all desirable economic development would be urgent for SA. In this regard, the Cluster 2 development should be viewed as a significant benefit to the SA economy. An estimated 2.6 million people lost their jobs due to the pandemic and the current unemployment rate is ~34%. Socio-economic indicators are likely to continue to decline and therefore Tetra4 and its suppliers could expect a disproportionate amount of job applications.

8.5.2 LOCAL ECONOMY

The total GGP of the Matjhabeng municipality is estimated at R45 billion at present and this can be considered as a large economy by size in South Africa. SA's GDP is just under R5 000 billion rand and although Matjhabeng's economy is only ~1 % of that amount, it needs to be compared to the 0,2 % of the average municipality in SA. Thus, Matjhabeng's economy is 5 times larger than the average municipality in SA and hence could be considered as a relatively big economy in the country. The significance of this is that the local area has a reasonable economic base that could sustain itself and as a rule ought to provide in some of Tetra4's supplier and procurement needs.

As shown in Figure 66 to Figure 69 below, the local economy's GDP growth rates had been mostly negative between 2005-2014. As the data for the local economy's performance was not available after 2014, a look at the SA GDP growth rate shows that nationally there were no signs to indicate that the economy was improving. One could therefore assume that the local economy may also not have experienced strong growth, albeit that higher commodity prices may have had a positive impact locally in 2021 (that year's statistic not in the graph.)

From the figures below it can also be seen that the mining industry made up 56 % of the local economy in 2014. Compare this to national mining contribution to GDP of less than 10 %. The Government sector, which is not a propulsive industry, is the next biggest economic sector in Matjhabeng. The critical sector for economic success namely the manufacturing sector is very small in that economy.

Mining output in the local economy is showing a downward trend at a rate of 1.5 % per year. Figure 69 shows that Matjhabeng had been hit hard by declining gold production. Its workforce had been halved since the golden years of the 1990's and this had led to high unemployment rates.

The area's population is large with well over 400 000 inhabitants. The population growth rate in Matjhabeng was estimated at 0,5 % in the last decade, compared to 1,5 % in SA, which indicates that the Gold Fields is not a major in-migration area at present. This can only be ascribed to the area's inability to absorb jobseekers in the economy prompting less people to in-migrate. As is the case in the rest of South Africa, the Matjhabeng unemployment rate is high, bordering on 40 %.

Due to the urbanised nature of Matjhabeng, it's Agricultural Sector is small contributing less than 2 % to its economy. The agricultural sector in the region is much larger as is expected in the Free State, averaging 5 % of GDP.

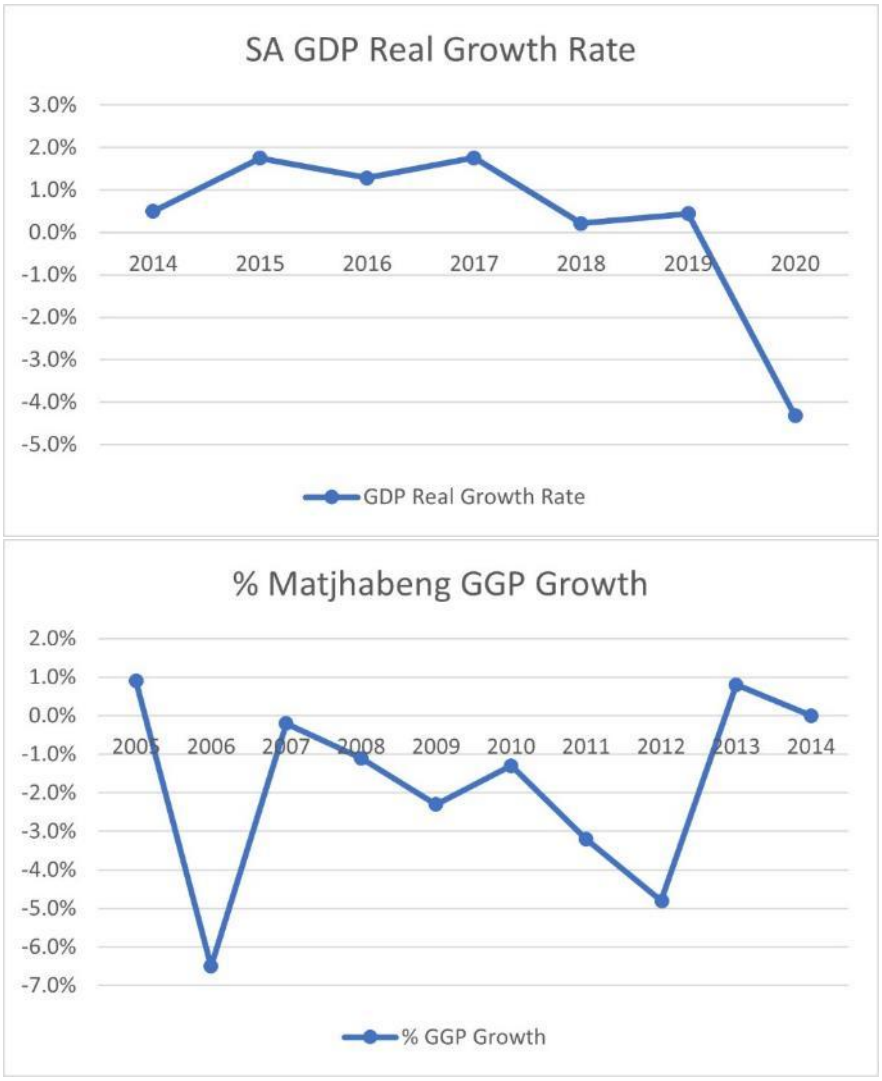


Figure 66: Key economic graphs.

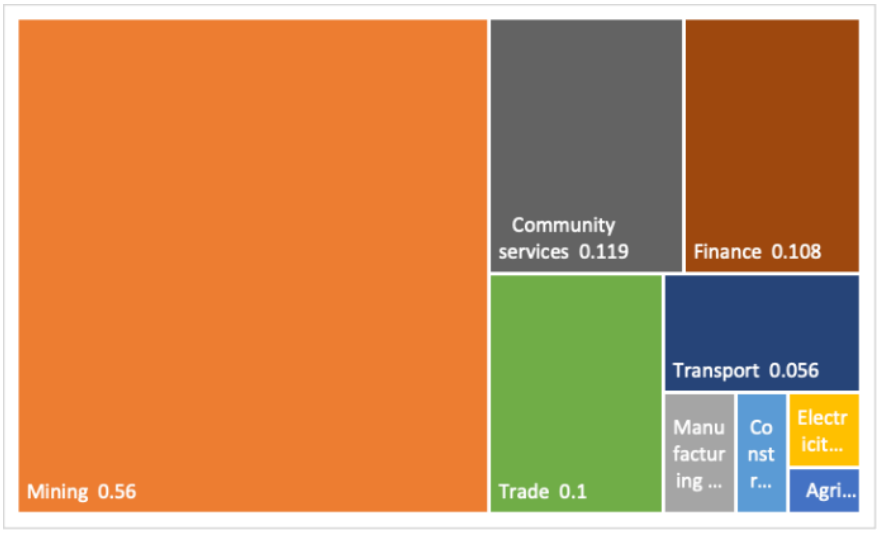


Figure 67: Structure of Matjhabeng economy by economic output 2014 – sector specific.

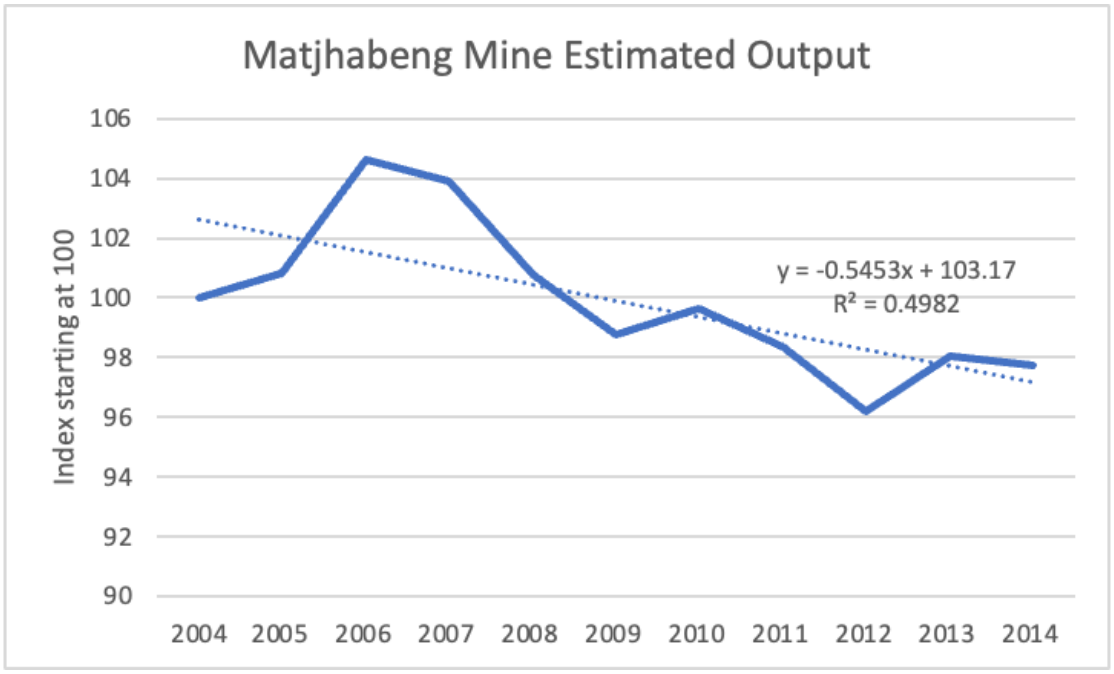


Figure 68: Structure of Matjhabeng economy by economic output 2014 – overall output.

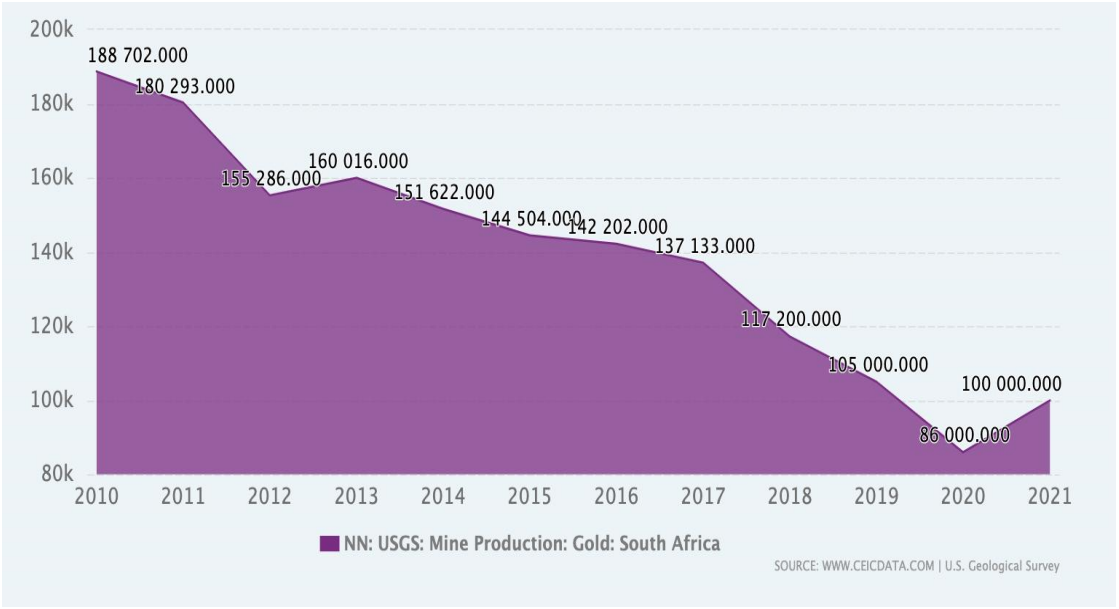


Figure 69: South African gold production.

8.5.2.1 STRENGTHS OF THE LOCAL ECONOMY

The local economy is considered to have the following strong points:

- Matjhabeng has a relatively large GGP compared to other municipalities, which ought to leverage possibilities for further development in the area.
- The road infrastructure from Matjhabeng that connects it to both the Johannesburg markets and Durban ports is of a very high quality, which makes import and export linkages more efficient than for many other municipalities in the country.
- Barring further mine closures, Matjhabeng may be finding a new economic equilibrium which ought to increase business confidence and investment in the area.

- The 2014/15 IDP indicates that the average household income has increased, which ought to contribute to social stability.
- The IDP also states that educational levels in the area have improved substantially, and a better-educated population is crucial for economic development.
- The IDP furthermore states that Matjhabeng has a Human Development Index (HDI) of 0.66, which is one of the highest in the Free State and just above the average SA HDI. However, the country's HDI is still low compared to that of developed countries, and it requires much improvement before Matjhabeng could be a significantly competitive economy.

8.5.2.2 WEAKNESSES OF THE LOCAL ECONOMY

- Matjhabeng is dependent on one propulsive industry, namely mining. With an undiversified economy it is thus vulnerable to the prospects of mining.
- The Matjhabeng municipality itself does not seem to have a strong set of financial statements. Its current liabilities exceed its current assets by a large margin, and it has been recording deficits (losses) for the last few years. In addition to this, it also had qualified audits which does not bode well for the financial management of the municipality.
- Other weaknesses are in alignment with what most of SA is experiencing at present:
    - Long term decline in business confidence;
    - Unreliable electricity supply;
    - Low growth economic environment;
    - Generally low investment environment;
    - High unemployment;
    - Unplanned urbanisation;
    - Crime;
    - Apparent government inefficiencies.

In summary, Matjhabeng has a relatively large economy compared to that of other SA municipalities, but its GGP has been declining for years. Although the local economy still has a measure of critical mass that could provide continued private consumption expenditure which could sustain it for quite some time, it requires new investments to sustain itself. The Matjhabeng economy is by all accounts finding a new equilibrium – an economy that is adjusting to declines in mining employment and a stagnating population. The increase in government expenditure and perennial agricultural activities are keeping the municipality's decline in check, but if more mines close down its GGP and formal employment is set to decline more. At present it is not sure what the impact of higher commodity prices are on the local economy. An investment such as that of Tetra4 will undoubtedly improve the economic prospects for the local economy.

9 ENVIRONMENTAL IMPACT ASSESSMENT

9.1 IMPACTS IDENTIFIED

This Section presents the impacts that have been identified and assessed for the BA. Potential environmental impacts were identified by the EAP, the appointed specialists (where applicable), as well as the preliminary input from the public. The impacts are included in .

When considering cumulative impacts, it is important to bear in mind the scale at which different impacts occur. The identification of impacts is an objective iterative process of considering the project components and activities and how these may interact with the different environmental components. An activity/ environmental component matrix is presented in Table 45 below. The matrix represents which environmental components are likely to be impacted upon by the project activities. Table 46 provides a list of the identified impacts associated with each environmental component.

Table 45: Impact Identification Matrix

Phase	Impact	Environmental Component													
		Climate and Air Quality (AQ)	Geology and soils (G)	Palaeontology (P)	Groundwater (GW)	Surface water/ wetlands (W)	Noise (N)	Topography (T)	Visual/ Landscape (V)	Flora (FL)	Fauna (FA)	Ecosystems/ habitats (EH)	Social (S)	Cultural Heritage (C)	Economic (E)
Planning and Design	Dust generation	X													
	Soil Compaction		X												
	Security												X		
Construction	Damage/destruction to known archaeological and heritage material													X	
	Damage/ destruction/disturbing of known graves													X	
	Loss of fossil Heritage		X												
	Soil compaction and erosion near watercourses		X												
	Impaired water quality due to accidental hydrocarbon spill					X									
	Disturbance of riparian vegetation									X					
	Increase in runoff/sediment transport of receiving systems		X												

Phase	Impact	Environmental Component													
		Climate and Air Quality (AQ)	Geology and soils (G)	Palaeontology (P)	Groundwater (GW)	Surface water/ wetlands (W)	Noise (N)	Topography (T)	Visual/ Landscape (V)	Flora (FL)	Fauna (FA)	Ecosystems/ habitats (EH)	Social (S)	Cultural Heritage (C)	Economic (E)
	Introduction and spread of alien and invasive vegetation									X					
Operations	Emissions	X													
	Soil Contamination		X												
	Groundwater Borehole Damage				X										
	Groundwater contamination				X										
	Hydrogeological alteration		X			X									
	Noise from vibroseis base plates						X								
	Visual alteration								X						
	Displacement of fauna										X				
	Habitat degradation											X			
	Security												X		

Phase	Impact	Environmental Component													
		Climate and Air Quality (AQ)	Geology and soils (G)	Palaeontology (P)	Groundwater (GW)	Surface water/ wetlands (W)	Noise (N)	Topography (T)	Visual/ Landscape (V)	Flora (FL)	Fauna (FA)	Ecosystems/ habitats (EH)	Social (S)	Cultural Heritage (C)	Economic (E)
	Agricultural activities												X		X
	Local Procurement												X		X
	Indirect loss, disturbance and increase in erosion and sedimentation to the receiving systems		X									X			
	Degradation of riparian vegetation and the introduction and spread of alien and invasive vegetation									X					
	Impaired water quality due to accidental hydrocarbon spill					X									
	Indirect loss, disturbance and degradation of wetlands					X									
	Degradation of wetland vegetation and the introduction and spread of alien and invasive vegetation									X					
	Contamination of wetlands with hydrocarbons due to machinery leaks and eutrophication of wetland systems with human sewerage and other waste.					X									
	Vibration transmission to watercourse											X			

Phase	Impact	Environmental Component													
		Climate and Air Quality (AQ)	Geology and soils (G)	Palaeontology (P)	Groundwater (GW)	Surface water/ wetlands (W)	Noise (N)	Topography (T)	Visual/ Landscape (V)	Flora (FL)	Fauna (FA)	Ecosystems/ habitats (EH)	Social (S)	Cultural Heritage (C)	Economic (E)
	Increase in erosion and sedimentation of receiving systems		X												
	Noise disturbance to aquatic/riparian fauna						X								
	Dust generation	X													
Decommissioning, Rehabilitation and Closure	Dust generation	X													
	Soil Compaction		X												
	Security												X		
	Agricultural activities												X		X

Table 46: Impacts identified and assessed during the BA.

#	Impact	Activity/ Aspect	Phase
AQ1 **AQ3** **AQ4**	Dust generation (Particulate Matter): Increased dust from heavy trucks driving on unpaved farm roads or off-road, especially during dry Free State winters.	Seismic study	Planning Operation Rehab and closure
AQ2	Emissions: Localized greenhouse gas and exhaust emissions (CO2, NOx, SOx) from heavy diesel vehicles and support machinery.	Seismic study	Operation
C1	Damage/destruction to known archaeological and heritage material	Vibroseis truck	Construction
C2	Damage/ destruction/disturbing of known graves	Vibroseis truck	Construction
EH1	Habitat degradation	Vibroseis truck	Operation
EH2	Indirect loss, disturbance and increase in erosion and sedimentation to the receiving systems	Seismic study	Operation
EH5	Vibration transmission to watercourse	Vibroseis truck	Operation
FA1	Displacement and increased mortality of fauna: Temporary displacement of local wildlife and livestock due to noise, vibrations, and human presence. Minor risk of vehicle-wildlife collisions (roadkill) or crushing of slow-moving reptiles/insects along off-road tracks.	Seismic study	Operation
FL1	Degradation of riparian vegetation and the introduction and spread of alien and invasive vegetation.	Seismic study	Operation
FL2	Degradation of wetland vegetation and the introduction and spread of alien and invasive vegetation	Seismic study	Operation
FL3	Disturbance of riparian vegetation	Seismic study	Construction
FL4	Introduction and spread of alien and invasive vegetation	Seismic study	Construction
G1 **G3** **G5** **G7**	Increase in soil compaction, erosion and sedimentation of receiving systems: Compression of topsoil by heavy vibroseis trucks (often weighing 20-30 tons), potentially affecting soil structure. Creation of vehicle ruts that could channelize runoff and lead to localized soil erosion. Increased siltation in nearby water bodies resulting from soil erosion along vehicle tracks.	Seismic study	Planning Rehab and closure Construction Operation

#	Impact	Activity/ Aspect	Phase
G2	Soil contamination: Localised pollution from accidental hydrocarbon spills (diesel, hydraulic fluid, oil) from machinery	Seismic study	Operation
G4	Loss of fossil Heritage	Seismic study	Construction
G6	Increase in runoff/sediment transport of receiving systems	Seismic study	Construction
GW1	Borehole damage: localized vibration damaging structurally unsound boreholes	Seismic study	Operation
GW2	Contamination Risk: Minor risk of shallow groundwater contamination if surface hydrocarbon spills are left unmanaged and infiltrate the soil.	Seismic study	Operation
N1	Noise from vibroseis base plates: Low-frequency rumbling and physical ground vibrations generated by the vibroseis base plates during sweeping.	Vibroseis truck	Operation
N2	Noise disturbance to aquatic/riparian fauna: Elevated ambient noise levels from heavy diesel engines, hydraulic systems, and support vehicles.	Seismic study	Operation
S1 **S2** **S6**	Security: compromised access control (such as unsecured gates), accidental damage to fencing, and the potential for opportunistic theft or the unauthorized scouting of farm security layouts.	Seismic study	Planning Operation Rehab and Closure
S3 **S7**	Agricultural disruption: Temporary interference with farming activities, seasonal crop production/harvesting/seeding, or temporary loss of grazing land due to traverse lines.	Seismic study	Operation Rehab and Closure
S4	Local Procurement: Minor, short-term economic benefits from the survey crews utilizing local accommodation, catering, and services in Welkom and surrounding towns.	Seismic study	Operation
S5	Landowner disruptions: force landowners to alter their daily operational schedules, delaying the movement of their own agricultural machinery and/or livestock, and potential damage to fences/gates,	Seismic study	Operation
V1	Visual alteration: Temporary alteration of the rural/agricultural sense of place due to the visible presence of large machinery convoys and work crews	Seismic study	Operation
W1	Indirect loss, disturbance and degradation of wetlands	Vibroseis truck	Operation

#	Impact	Activity/ Aspect	Phase
W2	Contamination of wetlands with hydrocarbons due to machinery leaks and eutrophication of wetland systems with human sewerage and other waste.	Vibroseis truck	Operation
W3	Hydrological Alteration: Damage to sensitive wetland areas, drainage lines, or ephemeral pans (common around Welkom) if traversed by heavy vehicles	Seismic study	Operation
W4 **W5**	Impaired water quality due to accidental hydrocarbon spill	Seismic study	Operation Construction

9.2 IMPACT ASSESSMENT METHODOLOGY

The impact significance rating methodology, as presented herein and utilised for all EIMS Impact Assessment Projects, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The approach may be altered or substituted on a case-by-case basis if the specific aspect being assessed requires such- such instances require prior EIMS Project Manager approval. The broad approach to the significance rating methodology is to determine the significance (S) of an environmental risk or impact by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relating this to the probability/ likelihood (P) of the impact occurring. The S is determined for the pre- and post-mitigation scenario. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the S to determine the overall final significance rating (FS). The impact assessment will be applied to all identified alternatives.

9.2.1 DETERMINATION OF SIGNIFICANCE

The final significance (FS) of an impact or risk is determined by applying a prioritisation factor (PF) to the post-mitigation environmental significance. The significance is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and Reversibility (R) applicable to the specific impact. For the purpose of this methodology the consequence of the impact is represented by:

$$\boldsymbol{C = \frac{(E + D + M + R) * N}{4}}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 47 below.

Table 47: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. Highly localised, limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property or site boundary, or the area within a few hundred meters of the site)
	3	Local (i.e. beyond the site boundary within the Local administrative boundary (e.g. Local Municipality) or within consistent local geographical features, or the area within 5 km of the site)

Aspect	Score	Definition
	4	Regional (i.e. Far beyond the site boundary, beyond the Local administrative boundaries within the Regional administrative boundaries (e.g. District Municipality), or extends into different distinct geographical features, or extends between 5 and 50 km from the site).
	5	Provincial / National / International (i.e. extends into numerous distinct geographical features, or extends beyond 50 km from the site).
Duration	1	Immediate (<1 year, quickly reversible)
	2	Short term (1-5 years, less than project lifespan)
	3	Medium term (6-15 years)
	4	Long term (15-65 years, the impact will cease after the operational life span of the project)
	5	Permanent (>65 years, no mitigation measure of natural process will reduce the impact after construction/ operation/ decommissioning).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected)
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected, or affected environmental components are already degraded)
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; moderate improvement for +ve impacts; or where change affects area of potential conservation or other value, or use of resources).
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease; high improvement for +ve impacts; or where change affects high conservation value areas or species of conservation concern)
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease, substantial improvement for +ve impacts; or disturbance to pristine areas of critical conservation value or critically endangered species)
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring very high time and cost.
	5	Irreversible Impact.

Once the C has been determined, the significance is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per Table 48.

It is noted that both environmental risks as well as environmental impacts should be identified and assessed. Environmental Risk can be regarded as the potential for something harmful to happen to the environment, and in many instances is not regarded as something that is expected to occur during normal operations or events (e.g. unplanned fuel or oil spills at a construction site). Probability and likelihood are key determinants or variables of environmental risk. Environmental Impact can be regarded as the actual effect or change that happens to the environment because of an activity and is typically an effect that is expected from normal operations or events (e.g. vegetation clearance from site development results in loss of species of concern). Typically, the probability of an unmitigated environmental impact is regarded as highly likely or certain (management and mitigation measures would ideally aim to reduce this likelihood where possible). In summary, environmental risk is about what could happen, while environmental impact is about what does happen.

Table 48: Probability/ Likelihood Scoring

Probability	1	Improbable (Rare, the event may occur only in exceptional circumstances, the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <5% chance).
	2	Low probability (Unlikely, impact could occur but not realistically expected; >5% and <20% chance).
	3	Medium probability (Possible, the impact may occur; >20% and <50% chance).
	4	High probability (Likely, it is most probable that the impact will occur- > 50 and <90% chance).
	5	Definite (Almost certain, the impact is expected to, or will, occur, >90% chance).

The result is a qualitative representation of relative significance associated with the impact. Significance is therefore calculated as follows:

$$S = C \, x \, P$$

Table 49: Determination of Significance

Consequence	5- Very High[2]	5	10	15	20	25
	4- High	4	8	12	16	20
	3- Medium	3	6	9	12	15
	2- Low	2	4	6	8	10
	1- Very low	1	2	3	4	5
		1- Improbable	2- Low	3- Medium/ Possible	4- High/ Probable	5- Highly likely/ Definite
	Probability					

The outcome of the significance assessment will result in a range of scores, ranging from 1 through to 25. These significance scores are then grouped into respective classes as described in Table 50.

Table 50: Significance Scores

[2] In the event that an impact or risk has very high or catastrophic consequences, but the likelihood/ probability is low, then the resultant significance would be Low-medium. This does in certain instances detract from the relative important of this impact or risk and must consequently be flagged for further specific consideration, management, mitigation, or contingency planning.

S Score	Description
≤4.25	Low (i.e. where this impact is unlikely to be a significant environmental risk/ reward).
>4,25, ≤8.5	Low-Medium (i.e. where the impact could have a significant environmental risk/ reward).
>8.5, ≤13.75	High-Medium (i.e. where the impact could have a significant environmental risk/ reward).
>13.75	High (i.e. where the impact will have a significant environmental risk/ reward).

The impact significance will be determined for each impact without relevant management and mitigation measures (pre-mitigation significance), as well as post implementation of relevant management and mitigation measures (post-mitigation significance). This allows for a prediction in the degree to which the impact can be managed/mitigated.

9.2.2 IMPACT PRIORITIZATION

Further to the assessment criteria presented in the section above, it is necessary to consider each potentially significant impact in terms of:

1. Cumulative impacts; and
2. The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impacts' post-mitigation significance (post-mitigation). This prioritisation factor does not aim to detract from the significance ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the post-mitigation significance based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 51: Criteria for Determining Prioritisation

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/ definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable Loss of Resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 51. The impact priority is therefore determined as follows:

$$\boldsymbol{Priority = CI + LR}$$

The result is a priority score which ranges from 2 to 6 and a consequent PF ranging from 1 to 1.5 (Refer to Table 52).

Table 52: Determination of Prioritisation Factor

Priority	Prioritisation Factor
2	1
3	1.125
4	1.25
5	1.375
6	1.5

In order to determine the final impact significance (FS), the PF is multiplied by the post-mitigation significance scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a factor of 0.5, if all the priority attributes are high (i.e. if an impact comes out with a high medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a higher significance).

Table 53: Final Environmental Significance Rating

Significance Rating	Description
<-25	**Very High (Impacts in this class are extremely significant and pose a very high environmental risk. In certain instances these may represent a fatal flaw. They are likely to have a major influence on the decision and may be difficult or impossible to mitigate. Offset's may be necessary.**
<-13.75 to -25	High negative (These impacts are significant and must be carefully considered in the decision-making process. They have a high environmental risk or impact and require extensive mitigation measures).
-8.5 to -13.75	Medium-High negative (i.e. Impacts in this class are more substantial and could have a significant environmental risk. They may influence the decision to develop in the area and require more robust mitigation measures).
<-4.25 to <-8.5	Medium- Low negative (i.e. These impacts are slightly more significant than low impacts but still do not pose a major environmental risk. They might require some mitigation measures but are generally manageable).
-1 to -4.25	Low negative (i.e. Impacts in this class are minor and unlikely to have a significant environmental risk. They do not influence the decision to develop in the area and are typically easily mitigated.
0	No impact
1 to 4.25	Low positive

Significance Rating	Description
>4.25 to <8.5	Medium-Low positive
8.5 to 13.75	Medium-High positive
>13.75	High positive

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.

9.3 DESCRIPTION AND ASSESSMENT OF IMPACTS

This section presents the impacts that have been assessed for the BA. Potential environmental impacts were identified by the EAP, the appointed specialists, as well as the preliminary input from the public. The impacts are included in Table 46. It should be noted that this report is currently made available to I&APs for review and comment, to ensure their comments and concerns were able to be addressed in the final BA Report to be submitted to the PASA/DMPR for adjudication.

The Impacts were assessed in terms of nature, significance, consequence, extent, duration and probability in line with the methodology described in Section 9.2 above. The impact assessment matrix (including pre- and post-mitigation assessment) is included in Appendix F. Without proper mitigation measures and continual environmental management, most of the identified impacts may potentially become cumulative, affecting areas outside of their originally identified zone of impact. The potential cumulative impacts have been identified, evaluated, and mitigation measures suggested and have been updated during the investigation.

9.3.1 CLIMATE AND AIR QUALITY (AQ)

The proposed 3D seismic survey for helium and methane exploration in the Welkom area will involve the deployment of heavy mechanical equipment, primarily vibroseis trucks, operating in a grid formation across the designated survey area. While the exploration activity is non-invasive and temporary in nature, the movement of heavy fleet vehicles across predominantly unpaved, agricultural, or natural terrains will inevitably interact with the local atmospheric environment. The baseline air quality in the Welkom area is historically influenced by surrounding agricultural activities, seasonal veld fires, and windblown dust from legacy gold mining tailings facilities. During the dry winter and windy spring months, the region is particularly susceptible to elevated levels of atmospheric particulate matter. These baseline conditions must be considered when evaluating the cumulative air quality impact of the survey activities.

The primary atmospheric emissions associated with the seismic survey are anticipated to be localised, short-term, and of low intensity. The impacts are categorised into two main streams namely fugitive dust generation (Particulate Matter) and vehicle/machinery emissions. The physical traversal of the vibroseis trucks and support vehicles across unpaved roads, farm tracks, and open veld will result in the entrainment of fugitive dust (specifically PM10 and PM2.5. The grid formation requires extensive off-road driving, which will disturb surface soils. The severity of this impact is highly dependent on soil moisture content, silt loading of the surface, and prevailing meteorological conditions (wind speed). The operation of diesel-powered vibroseis trucks and 4x4 support vehicles will result in the release of localized combustion emissions. These include carbon monoxide (CO), nitrogen oxides (NO_X), sulphur dioxide (SO_2), volatile organic compounds (VOCs), and fine diesel particulate matter.

All activities must comply with the general environmental duty of care as stipulated in Section 28 of the National Environmental Management Act (NEMA) (Act No. 107 of 1998) and the National Environmental Management:

Air Quality Act (NEMAQA) (Act No. 39 of 2004), specifically regarding the National Dust Control Regulations. To ensure that air quality impacts remain within acceptable limits and do not constitute a nuisance to local landowners or surrounding communities, mitigation measures (listed in Table 54) must be included in the Environmental Management Programme (EMPr) and strictly implemented.

Prior to mitigation, the impact on air quality is considered to be of Low to Medium significance due to the potential for localised dust nuisance affecting nearby farmsteads, particularly given the semi-arid conditions of the Free State. Following the strict implementation of speed controls and route management, the intensity of dust generation and vehicular emissions will be drastically reduced. The residual impact is therefore assessed to be of Low significance, as the effects will be highly localised, transient, and completely reversible upon the completion of the survey grid.

Table 54: Impact Assessment on Air Quality and Climate (AQ).

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Dust generation (AQ1)	Planning	Medium to low -	Low -	Low -
Emissions (AQ2)	Operation	Medium to low -	Medium to low -	Medium to low -
Dust generation (AQ3)	Rehab and Closure	Medium to low -	Low -	Low -
Dust generation (AQ4)	Operation	Low -	Low -	Low -
Potential cumulative/confounding effects	Cumulative air quality impacts would be related to the in-combination effects of the project's air emissions with existing emission sources and planned emissions in the immediate area around the project site, which could result in an elevation of ground level concentrations of pollutants and have an impact on the health of workers and local communities. Cumulative impacts on air quality are expected to be of minor priority. As such, no additional measures are proposed to manage cumulative effects.			
Mitigation Measures				
• **Speed Restrictions: A strict speed limit of 30 km/h must be enforced for all survey vehicles (including vibroseis and support vehicles) when travelling on unpaved roads and off-road tracks to significantly reduce dust entrainment** • **Route optimization: The grid traversal plan must utilise existing farm roads, tracks, and firebreaks as far as possible, before charting new off-road paths.** • **Meteorological Monitoring: Dust-generating activities (specifically off-road traversing) should be temporarily scaled back or halted during periods of high wind speeds blowing in the direction of sensitive receptors (farmsteads or residential zones).** • **Vehicle Maintenance: All vibroseis trucks and support vehicles must undergo regular servicing and maintenance to ensure optimal engine performance and minimise exhaust emissions.** • **Grievance Mechanism: Establish a direct line of communication with local landowners to report any excessive dust nuisance, allowing for immediate corrective action by the site manager.**				

9.3.2 GEOLOGY AND SOILS (G)

The seismic study utilises vibroseis technology, which introduces low-frequency acoustic energy into the subsurface via a vibrating baseplate. The vibroseis method is entirely non-intrusive, i.e. the acoustic waves do not physically alter, fracture, or displace the underlying geological formations, therefore the impact on the structural geology and mineral resources of the area is considered Negligible.

As the most critical receiving environment at the surface, the soils are highly susceptible to the physical presence of the vehicles, machinery and surface infrastructure. Vibroseis trucks are heavily weighted (typically ranging from 20 to 30 metric tonnes) to ensure adequate coupling with the ground. Repeated off-road traversing, especially if vehicles follow the same tracks, will significantly increase soil bulk density and reduce macro-porosity. In agricultural settings, this compaction restricts root penetration, decreases water infiltration rates, and lowers crop yields. Compaction is exponentially more severe if traversing occurs on wet soils, particularly those with higher clay fractions found in valley bottoms. The shearing force of heavy tires destroys the topsoil structure and biological soil crusts. This physical impact creates a loose surface layer of fine particulates, increasing the soil's susceptibility to both wind erosion (especially during the windy months) and sheet erosion during high-intensity thundershowers. Localized soil contamination may occur due to hydrocarbon leaks (diesel, hydraulic fluids, or lubricants) from the vibroseis baseplate hydraulics or vehicle engines.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Soil Compaction (G1)	Planning	Medium to low -	Low -	Low -
Soil Contamination (G2)	Operation	Medium to high -	Medium to low -	Medium to low -
Soil Compaction (G3)	Rehab and Closure	Medium to low -	Low -	Low -
Soil compaction and erosion near watercourses (G4)	Construction	Medium to low -	Low -	Low -
Increase in runoff/sediment transport of receiving systems (G5)	Construction	Medium to low -	Low -	Low -
Increase in erosion and sedimentation of receiving systems (G6)	Operation	Medium to low -	Low -	Low -
Potential cumulative/confounding effects	Cumulative impacts for soils relate specifically to loss of land with agricultural potential and loss of grazing land. Cumulative impacts are expected to be of low significance.			
Mitigation Measures				
• **Traversing must be limited during 24 to 48 hours following significant rainfall events (e.g., >10 mm), or until the soil surface has dried enough to prevent severe, deep-profile compaction and rutting.** • **The survey grid must be explicitly to use existing farm roads, fence lines, and firebreaks as far as possible.** • **Vehicles must carry industry-standard spill kits. Drip trays must be utilized whenever vehicles are parked for prolonged periods. Any contaminated soil must be immediately excavated, stored in sealed bins, and disposed of at a registered hazardous waste facility.**				

9.3.3 PALAEONTOLOGY (P)

Although the SAHRIS PalaeoMap indicates that the study area falls within a zone of Very High Palaeontological Sensitivity, the significance of potential impacts associated with the proposed survey is assessed as Very Low, owing to the non-invasive nature of the activities. As no vegetation clearance or subsurface disturbance will

occur, the proposed survey is not expected to result in any direct impacts on palaeontological heritage resources.

Should any fossil material be encountered during any phase of the project, whether exposed at surface or during unforeseen ground-disturbing activities, the Chance Find Protocol must be implemented immediately by the Environmental Control Officer (ECO) or the responsible site manager. All fossil discoveries must be protected in situ and reported to the South African Heritage Resources Agency (SAHRA) to ensure that appropriate recording and, where necessary, collection can be undertaken by a qualified palaeontologist.

Prior to the collection of any fossil material, a permit must be obtained from SAHRA by the appointed specialist. All collected material must be curated in an accredited museum or university repository, and all reporting and fieldwork must comply with the minimum standards for palaeontological impact studies as prescribed by SAHRA (2012). It is therefore recommended that no further palaeontological studies, field verification or mitigation measures are required, unless previously unknown fossil material is discovered.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Loss of fossil Heritage (P1)	Construction	High -	Medium to low -	Medium to low -
Potential cumulative/confounding effects	Cumulative impacts on fossil resources are expected to be negligible – low.			
Mitigation Measures				
• **The palaeontologist must apply for a valid permit from SAHRA for the collection/removal of fossils encountered during the survey.** • **If fossils are encountered and reported, a palaeontologist must be appointed to remove the fossils after applying for a valid collection permit from SAHRA.**				

9.3.4 GROUNDWATER (GW)

While the proposed seismic survey is a surface-based exploration method that does not involve deep drilling, hydraulic fracturing, or the extraction of fluids, the utilisation of heavy vibroseis equipment introduces specific, localized risks to the receiving groundwater environment.

Vibroseis trucks operate by lowering a heavy baseplate to the ground and sweeping through a range of low-frequency acoustic vibrations (typically between 5 Hz and 100 Hz). The resulting seismic waves travel through the subsurface. If this vibrational energy is introduced in close proximity to an existing, equipped borehole, the localized ground acceleration and peak particle velocity (PPV) may cause physical shearing, cracking, or collapse of the borehole casing. Additionally, severe vibration can dislodge sediment, clogging borehole screens and pumps, or alter the immediate localised fracture network, leading to a sudden reduction in borehole yield or total loss of the water resource.

Unmitigated, this impact is considered of Medium to High significance. While the spatial extent of a single damaged borehole is localised, the intensity is high due to the high replacement cost of borehole infrastructure and the severe operational impact on a farm's water security.

The operation of a large fleet of diesel-powered vibroseis trucks and 4x4 support vehicles across the survey grid introduces the risk of localized hydrocarbon spills (diesel, oil, and specialized hydraulic fluids used in the vibroseis baseplate mechanisms). While these are surface spills, contaminants can rapidly infiltrate shallow, unconfined aquifers, particularly if the spill occurs on highly permeable soils, during rainfall events, or directly adjacent to preferential flow pathways such as unsealed/abandoned boreholes or outcropping fracture zones.

Prior to mitigation, this impact is assessed as Medium to Low. Although the volumes of potential spills are relatively small (limited to the capacity of the vehicle's reservoirs), hydrocarbon contamination of groundwater is persistent, difficult to remediate, and directly threatens potable water supplies.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Groundwater Borehole Damage (GW1)	Operation	Medium to high -	Medium to low -	Medium to low -
Groundwater contamination (GW2)	Operation	Medium to low --	Medium to low --	Medium to low -
Potential cumulative/confounding effects	Cumulative groundwater impacts are expected to be low – moderate as there are no significant existing sources of groundwater contamination in the area.			
Mitigation Measures				
• **Prior to site mobilisation, a hydrocensus must be conducted across the survey grid to identify the locations of boreholes. This involves consulting with landowners to locate and assess the baseline status (e.g. depth, yield, and equipment) of all active, inactive, and abandoned boreholes, springs, and wells.** • **This is the primary mitigation strategy for structural damage. A buffer zone of at least 100 m to 150 m (depending on the specific vibroseis energy output and local geological attenuation factors) must be delineated around all identified boreholes and water points. Vibroseis source points must be offset if they fall within this radius. Support vehicles may traverse these zones, but active vibration should be avoided.** • **Where survey lines must necessarily pass near critical water infrastructure or sensitive farm buildings, peak particle velocity (PPV) seismographs should be temporarily deployed to ensure ground vibration limits do not exceed safe infrastructural thresholds.** • **Routine maintenance of the vibroseis hydraulic systems must be conducted off-site or within properly bunded workshop areas. In the field, all vehicles must be equipped with comprehensive hydrocarbon spill kits. Drip trays must be utilized during any stationary periods or minor field repairs.** • **Refuelling or parking of heavy machinery must be prohibited within 50 m of any known borehole, wetland, or drainage line to prevent rapid contaminant ingress.**				

9.3.5 SURFACE WATER / WETLANDS (W)

The proposed seismic survey is anticipated to result in localised, predominantly temporary disturbance within the project footprint, primarily associated with vehicle movement along the planned transect lines and related field activities. The principal freshwater-related risk is that ground disturbance – particularly under wet conditions – may lead to rutting/compaction, vegetation disturbance and the development of localised erosion hotspots, with the potential for increased sediment and contaminant mobilisation toward wetlands and drainage features. Although direct impacts to wetlands are not anticipated based on an avoidance approach, inappropriate routing, wet-weather access or uncontrolled driving could result in incidental encroachment into sensitive wetland areas.

The potential impacts associated with the proposed activities were assessed using the EIMS impact assessment methodology. The assessment focuses on the operational phase of the seismic survey. For each impact, significance was determined for the pre- and post-mitigation scenarios in accordance with the prescribed EIMS procedure. The results indicate that, provided the recommended mitigation measures are implemented, residual impacts on freshwater features are anticipated to be of low negative significance, with temporary disturbance during operations representing the primary residual risk.

Although direct impacts to the riverine areas (Riparian and active channels) are not anticipated based on an avoidance approach, inappropriate crossings, wet-weather access or uncontrolled driving could result in incidental encroachment into sensitive riparian areas. The assessment focuses on the operational phase of the seismic survey. For each impact, significance was determined for the pre- and post-mitigation scenarios in accordance with the prescribed EIMS procedure.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Indirect loss, disturbance and degradation of wetlands (W1)	Operation	Medium to low -	Low -	Low -
Contamination of wetlands with hydrocarbons due to machinery leaks and eutrophication of wetland systems with human sewerage and other waste (W2)	Operation	Medium to low -	Low -	Low -
Hydrogeological alteration (W3)	Operation	Medium to low -	Low -	Low -
Impaired water quality due to accidental hydrocarbon spill (W4)	Operation	Medium to low -	Low -	Low -
Impaired water quality due to accidental hydrocarbon spill (W5)	Construction	Medium to low -	Low -	Low -
Potential cumulative/confounding effects	The freshwater ecology of the project area is considered low to highly sensitive to disturbance from a hydrological, biological and conservational perspective. This includes several NFEPAs within the catchments Doring River and Boschluisspruit. The proposed exploration activities must take cognisance of this and avoid sensitive areas and any unnecessary disturbance of these areas. Development within these sensitive areas will lead to disruptions to the present ecological state and therefore ecosystem degradation. Localised cumulative impacts include the cumulative effects from anthropogenic activities that are close enough (such as nearby farming activities within the area) to potentially cause additive effects on the environment or sensitive receivers. These include disruption of ecological corridors or habitat such as watercourses, impacts to groundwater and surface water quality, and transport of soils and instream habitat smothering impacts. The cumulative impacts include the loss or alteration of watercourse system that maintains water quality for downslope aquatic systems when undisturbed), loss of interflow and the resulting deterioration of the systems to provide necessary ecological services. Following the implementation of appropriate mitigation, the cumulative impacts will remain as a low risk significance rating. Furthermore, should hazardous spillages occur, the associated FEPA areas could be contaminated and spilled materials could be carried from the contaminated soils into downstream freshwater systems during precipitation events.			

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Mitigation Measures				
• **Micro-site transect lines to avoid delineated wetlands (HGM 1–3), and demarcate no-go areas before operations.** • **Depressions (HGM 4): Vehicle access may be permitted only during the dry season and only when depressions are confirmed dry, with rerouting required if wetness/saturation is observed.** • **Keep vehicles to existing tracks and approved routes; no ad hoc detours or route widening near wet areas.** • **Prefer dry-season (June – August) operations and stop/reroute if soils are wet/saturated to prevent rutting and compaction.** • **Use single, pre-approved crossing points only where unavoidable, applying low-impact measures (no blading/excavation of wetland soils).** • **Restrict vehicle movement to approved routes and avoid delineated wetlands (HGM 1–3); only allow access through dry depressions (HGM 4) during the dry season when confirmed dry.** • **Minimise disturbance by keeping the operational footprint as small as practicable and prohibiting unnecessary vegetation disturbance/clearing.** • **Inspect and clean vehicles/equipment (wheels, undercarriages) before entering the site and when moving between properties to reduce weed seed transfer.** • **Monitor disturbed areas and access routes for alien/invasive plant establishment during and after operations, and remove/eradicate infestations as they arise (mechanical/hand removal or appropriate treatment).** • **Rehabilitate any disturbed areas promptly (re-profile, stabilise and re-vegetate as required using locally appropriate indigenous species or an agreed pasture mix, in consultation with the landowner).** • **Prohibit refuelling, servicing/maintenance and hazardous substance handling within wetlands (HGM 1–3); undertake these activities only at designated areas located away from freshwater features.** • **Ensure fuels, oils and hazardous substances are stored and handled with secondary containment (e.g., bunding/drip trays) and that vehicles are regularly inspected for leaks (repair leaks before re-entry to the field).** • **Maintain good housekeeping: no dumping/burying/burning of waste; store waste securely and remove regularly to licensed facilities; prevent litter accumulation and collect windblown litter promptly.** • **Keep spill kits available on all relevant vehicles/teams, and ensure staff are trained to respond to leaks/spills.** • **Implement spill response procedures: stop source, contain, clean up and dispose of contaminated material appropriately, and record/report incidents in accordance with site requirements; any spill near a freshwater feature triggers immediate escalation and remediation.** • **Prevent discharge of contaminated water to the environment; manage any contaminated runoff/wash water via appropriate containment and disposal (no release to drainage lines/wetlands).**				

9.3.6 NOISE (N)

The acoustic impacts associated with the seismic survey are entirely operational and transient. The impacts are categorised into two primary streams: general environmental noise and specific disturbances to sensitive ecological receptors.

The noise generated by the survey is two-fold. Firstly, there is the mechanical and combustion noise from the diesel engines of the 20 to 30 metric tonne vibroseis trucks and 4x4 support fleet navigating off-road terrain. Secondly, there is the characteristic low-frequency acoustic "sweep" generated by the vibrating base plates. While the primary energy is directed into the ground as seismic waves (typically between 5 Hz and 100 Hz), a portion of this energy is emitted as airborne acoustic noise. This low-frequency hum, combined with heavy

engine noise, can become a significant nuisance to sensitive human receptors (farmsteads, farm workers, and rural residents) situated within the survey grid.

Unmitigated, the impact on the ambient acoustic environment is considered of Medium to Low significance. Although the noise is temporary and mobile (the trucks do not remain stationary for long periods), the low-frequency nature of the base plate vibration can travel considerable distances and penetrate building structures more effectively than high-frequency noise.

The Welkom area features various surface water bodies, including seasonal pans and non-perennial drainage lines characteristic of the Free State landscape. These aquatic and riparian zones are critical refuge, foraging, and breeding habitats for local fauna, including avifauna (birds), amphibians, and small mammals. The sudden introduction of heavy, localised noise and ground-borne vibration from vibroseis trucks operating adjacent to these habitats can trigger stress and flight responses. This can lead to the temporary displacement of sensitive species, disruption of feeding or breeding patterns, and the potential abandonment of nests.

The unmitigated impact is assessed as Low. While the survey is not permanently destroying the habitat, the acoustic disturbance during critical breeding or migratory seasons can have localised ecological consequences for riparian-dependent species.

All survey activities must align with the general duty of care outlined in the National Environmental Management Act (NEMA) (Act No. 107 of 1998) and adhere to the guidelines set out in SANS 10103:2008 (The measurement and rating of environmental noise with respect to annoyance and to speech communication) for rural districts.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Noise from vibroseis base plates	Operation	Medium to low -	Medium to low -	Medium to low -
Noise disturbance to aquatic/riparian fauna	Operation	Low -	Low -	Low -
Potential cumulative/confounding effects	Noise impacts are by their nature cumulative with existing ambient noise levels.			
Mitigation Measures				
• **Active vibroseis operations must be completely avoided within ecologically sensitive habitats, such as seasonal pans and wetlands, during the breeding seasons to prevent acoustic stress and reproductive disruption to local fauna** • **To prevent sleep disturbance and align with natural diurnal faunal activity patterns, all active vibroseis sweeping and heavy vehicle movement must be strictly limited to daylight hours (e.g., 06:00 to 18:00).** • **Landowners must be provided with a rolling, weekly schedule of the grid traversal path. This allows farmers to anticipate the mobile noise footprint and temporarily relocate sensitive livestock if deemed necessary. A clear grievance mechanism must be established for noise complaints.**				

9.3.7 VISUAL / LANDSCAPE (V)

The proposed 3D seismic survey is a highly transient activity, but it introduces distinct, albeit temporary, alterations to the visual landscape.

The visual alteration stems primarily from the introduction of machinery into a rural setting. A fleet comprising 20 to 30-tonne vibroseis trucks and associated 4x4 support vehicles will actively traverse the survey grid. Furthermore, the off-road grid traversal physically flattens tall grasses and vegetation, creating temporary tracks.

Prior to mitigation, the visual impact is assessed as Low. While the machinery is visually intrusive, the impact is mitigated inherently by the continuous mobility of the operation. The fleet does not establish permanent or long-term stationary camps within the grid, meaning visual exposure to any single receptor is brief and highly localised.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Visual alteration (V1)	Operation	Low -	Low -	Low -
Potential cumulative/confounding effects	Cumulative visual impacts are expected to be low due to the temporary nature of the project.			
Mitigation Measures				
• **The fleet must utilise existing farm roads, fence line tracks, and firebreaks as far as possible.** • **Strict adherence to the 30 km/h speed limit on unpaved surfaces.** • **Active survey operations must remain restricted to daylight hours.** • **Strict waste management protocols must be enforced. Ensure that no litter, hydrocarbon spills, or temporary infrastructure (such as high-visibility flagging tape or pegs) are left behind.**				

9.3.8 FLORA (FL)

The proposed 3D seismic survey is anticipated to result in localised, predominantly temporary disturbance within the project footprint, primarily associated with vehicle movement along the planned transect lines and related field activities. Although direct impacts to the riverine areas (Riparian and active channels) are not anticipated based on an avoidance approach, inappropriate crossings, wet-weather access or uncontrolled driving could result in incidental encroachment into sensitive riparian areas. The potential impacts associated with the proposed activities were assessed using the EIMS impact assessment methodology, and the results are summarised in Table 4 1 .The assessment focuses on the operational phase of the seismic survey. For each impact, significance was determined for the pre- and post-mitigation scenarios in accordance with the prescribed EIMS procedure.

It should be noted that as the proposed activity intends to avoid sensitive environments (such as riparian zones with their delineated buffers and active channel), very low impacts is anticipated to the riverine features including aquatic biota. The impact assessment indicated that the risks/impacts from the proposed project are generally of "Medium to Low" significance prior to mitigation. With the application of mitigation measures, all impacts are reduced to "Low" significance, indicating effective management. The results confirm that, with proper controls, the long-term impacts on aquatic ecosystem health and function are minimal.

Should the layout and/or project description change, the impact assessment should be reviewed by a qualified Aquatic Ecologist.

The quantitative impact of the proposed project in isolation on terrestrial biodiversity is anticipated to be “low” due to the expected adherence to mitigation. The cumulative impact of the proposed project on habitats, plants and animals is anticipated to be “low”. The project area has undergone historic and current disturbance, like the disturbances that the local area has undergone.

After implementation of the mitigation measures as stipulated above the integrity and functionality of the natural habitat is not expected to deteriorate further as a result of the proposed development and no irreplaceable loss of terrestrial biodiversity is anticipated.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Degradation of riparian vegetation and the introduction and spread of alien and invasive vegetation (FL1)	Operation	Medium to low -	Low -	Low -
Degradation of wetland vegetation and the introduction and spread of alien and invasive vegetation (FL2)	Operation	Medium to low -	Low -	Low -
Disturbance of riparian vegetation (FL3)	Construction	Medium to low -	Low -	Low -
Introduction and spread of alien and invasive vegetation (FL4(	Construction	Medium to low -	Low -	Low -
Potential cumulative/confounding effects	The cumulative impact of the proposed project on habitats, plants and animals is anticipated to be "low". Potential cumulative impacts include the clearance of vegetation during the construction phase.			

Mitigation Measures

- **Avoid the creation of new access roads; use existing roads as far as possible.**
- **Minimise disturbance by keeping the operational footprint as small as practicable and prohibiting unnecessary vegetation disturbance/clearing.**
- **Inspect and clean vehicles/equipment (wheels, undercarriages) before entering the site and when moving between properties to reduce weed seed transfer.**
- **Monitor disturbed areas and access routes for alien/invasive plant establishment during and after operations and remove/eradicate infestations as they arise (mechanical/hand removal or appropriate treatment).**
- **Rehabilitate any disturbed areas promptly (re-profile, stabilise and re-vegetate as required using locally appropriate indigenous species or an agreed pasture mix, in consultation with the landowner).**
- **Restrict vehicle movement to approved routes and avoid delineated wetlands (HGM 1–3); only allow access through dry depressions (HGM 4) during the dry season when confirmed dry.**
- **No clearance or removal of Alien Invasive Plants (AIP) is permitted without an approved AIP Management Plan in place.**
- **Indigenous vegetation to be maintained (no clearing for seismic lines) to ensure biodiversity is maintained and to prevent soil erosion.**
- **Restrict all Seismic survey activities to authorised footprint areas only.**
- **If required, vegetation clearing commences only after the necessary permits for SCCs or protected plants have been obtained. Any individual of the protected plants that were observed needs a relocation or destruction permit for any individual to be removed or destroyed due to the development. High visibility flags must be placed near any protected plants to avoid any damage or destruction of the species. If left undisturbed the sensitivity and importance of these species needs to be part of the environmental awareness programme.**
- **When clearing vegetation, an ecologist will need to be on-site to assist in identifying SCCs or protected plants.**

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
• **Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed further. It is recommended that areas to be developed be specifically demarcated so that during the construction phase, only the demarcated areas be impacted upon.**				

9.3.9 FAUNA (FA)

The project activities will have a negative effect on the natural environment of the area. Anthropogenic activities drive habitat destruction leading to the displacement of fauna and flora and possibly causing direct mortality. Land clearing destroys local wildlife habitat and can lead to the loss of local breeding grounds, foraging and nesting sites, and wildlife movement corridors such as rivers, streams and drainage lines, or other locally important features. The removal of natural vegetation is likely to reduce the habitat available for all types of fauna species and hence reduce animal populations and species compositions within the area.

The species environmental guidelines SANBI (2020) indicate that specific directives contained within a Biodiversity Management Plan (BMP) must take precedence as mitigation measures. According to the guidelines, SANBI (2020), there is a BMP currently in development for the IUCN VU Sensitive Species 15 that specifically states that: 'Destruction of intact habitat with extant to Sensitive Species 15 populations is not permitted'. Therefore, avoidance mitigation and not minimisation mitigation would be applicable in such a case. Additionally, the protocols advise a minimum buffer of 250 meters, to up to 400 m buffer to be applied around the periphery of SS15 colonies, which in this case represent the Medium sensitivity area. There are no mitigation measures that can described in this report that will reduce the significance of the risk to an acceptable level, and hence no impact significance rating will be conducted. The Seismic survey activities within these Medium Sensitivity areas is considered 'No-Go".

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Displacement of faunal community due to habitat loss, direct mortalities and disturbance (road collisions, noise, dust, vibration and poaching	Operation	Medium to low -	Low -	Low -
Potential cumulative/confounding effects	The cumulative impact of the proposed project on habitats, plants and animals is anticipated to be "low".			
Mitigation Measures				
• **Prior to Seismic survey activities, the area should be walked on foot by 1-2 individuals to create a disturbance in order for fauna to move off. Disturbance must occur as soon before Seismic survey activities as possible and no unnecessary disturbance to the area is permitted** • **Any tortoises present should be removed from the affected areas before the start of Seismic survey activities and relocated them to safe areas within the PAOI.** • **Any fauna threatened by the Seismic survey activities should be removed safely by an appropriately qualified environmental officer or removal specialist.** • **To reduce any impact on the possible presence of significant burrowing mammal species, line clearance crews will be instructed at induction on the detection of these species scats and signs.** • **If these species are detected, then no ground disturbance will take place within 100 m of these areas.** • **Indications of the presence of these species need to be reported.**				

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance

- **Safely relocate any wildlife at risk from Seismic survey activities with the help of a qualified environmental officer or specialist.**
- **Limit Seismic crew vehicle speeds to 40 km/h to prevent accidents, and install appropriate speed control measures and signage.**
- **Driving on access roads at night should be restricted to maximum 20 km/h to reduce or prevent wildlife road mortalities which occur more frequently during this period.**
- **Focus work on one area at a time to reduce the extent of on-site activities, allowing wildlife to relocate as the project progresses. This helps smaller animals find refuge in nearby undisturbed areas.**
- **No nighttime Seismic survey activities to minimise disturbances to nocturnal species expected in the area.**
- **All project activities must be undertaken with appropriate noise mitigation measures to avoid disturbance to avifauna population in the region;**
- **The No-Go 400m buffer area for Degraded Grassland Sensitive Species must be avoided for Seismic survey activities.**
- **Provide all personnel and contractors to undergo Environmental Awareness Training to all personnel and contractors. A signed register of attendance must be kept for proof. Discussions The training must include.**
- **All personnel should undergo environmental induction with regards to avifauna and in particular awareness about not harming, collecting, or hunting terrestrial species, and owls, which are often persecuted out of superstition. Signs must be put up to enforce this.**
- **As far as possible cables on cable laying trucks should be insulated**
- **Where possible, instead of surveying the entire area at once, work on specific sections as needed. This approach involves focusing on one area at a time and following a systematic process. By doing so, the amount and scope of on-site activities are minimized, which allows wildlife to gradually relocate as the project advances. This method provides smaller birds, mammals, and reptiles the opportunity to cope with the disturbance by staying in nearby undisturbed areas that are close to their natural habitats.**
- **A nest walkdown must be performed prior to Seismic survey activities, by a suitably qualified person. If nests are found a suitably qualified specialist must be contacted to advise on the way forward.**
- **Keep noise levels low from dusk to dawn to avoid disturbing amphibians and nocturnal mammals.**

9.3.10 ECOSYSTEMS / HABITATS (EH)

Anthropogenic disturbances, such as vegetation clearance and physical habitat alteration, drive the displacement of local fauna and the eradication of flora, carrying the potential for direct mortalities. Such landscape disturbances compromise critical wildlife habitats, leading to the loss of established breeding grounds, foraging and nesting sites, and essential ecological movement corridors (including drainage lines and streams). Consequently, the degradation of natural vegetation reduces the overall carrying capacity of the habitat, negatively altering local animal population dynamics and species composition.

The proposed activity has been explicitly designed to avoid highly sensitive ecological receptors. By actively bypassing riverine environments, including riparian zones, their delineated buffers, and active channels, the anticipated impact on aquatic biota and hydrological features is deemed to be exceptionally low. Given this strategic avoidance, detailed assessments of these specific riverine impacts have been scoped out of this report.

The impact assessment indicates that the potential ecological risks associated with the proposed project are generally of "Medium to Low" significance prior to mitigation. Following the strict application of the prescribed mitigation measures, all identified impacts are successfully reduced to a "Low" residual significance. This confirms that, with effective environmental management and control protocols in place, the long-term impacts on both the terrestrial landscape and overall aquatic ecosystem health will remain minimal.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Habitat degradation (EH1)	Operation	Medium to high -	Medium to low -	Medium to low -
Indirect loss, disturbance and increase in erosion and sedimentation to the receiving systems (EH2)	Operation	Medium to low -	Low -	Low -
Vibration transmission to watercourse (EH5)	Operation	Medium to low -	Low -	Low -
Potential cumulative/confounding effects	The cumulative impact of the proposed project on habitats, plants and animals is anticipated to be "low".			
Mitigation Measures				
• **Micro-site transect lines to avoid delineated riparian areas and demarcate no-go areas before operations.** • **Keep vehicles to existing tracks and approved routes; no ad hoc detours or route widening near wet areas.** • **Prefer dry-season operations and stop/reroute if soils are wet/saturated to prevent rutting and compaction.** • **Use single, pre-approved crossing points only where unavoidable, applying low-impact measures (no blading/excavation of riparian or river bed soils).**				

9.3.11 SOCIAL (S)

The deployment of the seismic survey crew introduces unfamiliar vehicles and personnel into a traditionally closed rural network. In an environment where farm theft, poaching, and rural crime are heightened sensitivities, the sudden presence of an exploration team can significantly elevate anxiety among landowners and farm workers. Uncoordinated access or wandering personnel can trigger farm security protocols or local community policing forums (farm watches). Unmitigated, the impact on perceived and actual rural security is assessed as Medium to High, primarily due to the severe social sensitivity surrounding farm safety in the Free State.

The physical traversal of the vibroseis fleet and support vehicles across the survey grid intersects directly with active farming operations. Potential disruptions include the need to temporarily move livestock to avoid the fleet, interference with seasonal planting or harvesting machinery, and the critical risk of gates being left open, which can lead to the mixing of breeding herds or livestock escaping onto public roads. Furthermore, accidental damage to farm infrastructure (e.g., snapping strained boundary fences or damaging water troughs) directly impacts agricultural productivity. Prior to mitigation, this impact is considered of Medium to High significance, as it directly affects the primary economic livelihood of the receiving environment.

Beyond direct agricultural interference, the survey constitutes a general disruption. The presence of the fleet disrupts the day-to-day activities of the rural living environment. Unscheduled delays or deviations from agreed-upon grid paths can disrupt landowners, requiring them to repeatedly alter their daily management plans to accommodate the exploration crew. Unmitigated, this impact is assessed as Medium to Low.

While the technical operation of a vibroseis truck requires specialised, non-local skills, the broader survey campaign presents opportunities for localised economic injection. This includes the temporary procurement of local unskilled or semi-skilled labour for tasks such as fence repair, gate management, or site security. The positive impact is Low to Medium, given the short duration of the survey.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Security	Planning	Medium to low -	Medium to low -	Medium to low -
Security	Operation	Medium to high -	Medium to low -	Medium to low -
Agricultural activities	Operation	Medium to high -	Medium to low -	Medium to low -
Local Procurement	Operation	Low to medium +	Low to medium +	Low to medium +
Landowner disruptions	Operation	Medium to low -	Medium to low -	Medium to low -
Security	Rehab and Closure	Medium to high -	Medium to low -	Medium to low -
Agricultural activities	Rehab and Closure	Medium to low -	Low -	Low -
Potential cumulative/confounding effects	The physical footprint of existing production activities already removes portions of arable or grazing land from agricultural circulation and introduces continuous heavy vehicle traffic on local farm roads. Overlaying a 3D seismic grid onto this landscape increases disruption for the landowner. The compounding presence of production trucks and the mobile vibroseis fleet increases the degradation of shared unpaved farm roads. Furthermore, the farmer is forced to navigate livestock management and seasonal planting around both semi-permanent exclusion zones (wellpads) and the continuously moving exclusion zones of the seismic fleet, leading to severe spatial constriction and scheduling conflicts. The sustained presence of gas operations means landowners are continuously engaged in access negotiations, grievance resolutions, and daily operational planning with the current operators. Adding the intensive, highly intrusive nature of a grid-based seismic survey (which traverses the entirety of a property, compromising privacy) threatens to exhaust the landowners' tolerance. This "consultation fatigue" and cumulative loss of privacy can rapidly erode the project's overarching social license to operate, transforming general nuisance into active hostility and strained stakeholder relations.			
Mitigation Measures				
• **All survey personnel must undergo security vetting prior to deployment. Every crew member must wear high-visibility, branded clothing and carry formal photographic identification at all times. All project vehicles must be clearly marked. The local South African Police Service (SAPS) and local farm watch coordinators must be notified of the exact dates, vehicle registration numbers, and personnel headcounts prior to site entry.** • **Written access agreements must be negotiated with every affected landowner prior to mobilisation. The survey schedule must avoid actively harvested or planted fields where possible. Ideally the seismic activities should take place during fallow seasons, unless an agreement is in place between the landowners and the applicant. Landowners must receive a minimum of 5 business days' notice before the fleet enters their specific property boundaries.** • **A strict "leave it as you found it" gate policy must be enforced. A dedicated Community Liaison Officer (CLO) or designated gate operator must travel ahead of the fleet to manage access and ensure all gates are secured immediately after the convoy passes. A compensation mechanism must be established to repair any accidental damage to fences, roads, or water infrastructure.** • **A strict zero-tolerance code of conduct must be signed by all crew members, prohibiting the handling of livestock, harvesting of crops, poaching, lighting of open fires, or entering farmsteads without an explicit invitation.**				

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
• **The project proponent must identify and utilise local suppliers in the Welkom area and procure local skilled and un-skilled workers as far as possible.**				

9.3.12 CULTURAL HERITAGE (C)

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camp areas and small-scale infrastructure development associated with the project.

It is possible that cultural material will be exposed during construction and may be recoverable, keeping in mind that delays can be costly during construction, and as such must be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance; however, foundation holes do offer a window into the past, and it may thus be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project, and these must be catered for. Temporary infrastructure developments, such as construction camps and laydown areas, are often changed or added to the project as required. In general, these are low-impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

The study area occurs within a greater historical and archaeological context as identified during the desktop and fieldwork phase. Soil clearance for infrastructure as well as the proposed reclamation activities, could uncover the following:

- Historical structures and foundations
- Unmarked BGG
- Archaeological sites or resources
- Palaeontological sites or resources

It must be kept in mind that mitigation and monitoring of heritage resources discovered during construction activity will require permitting for the collection or excavation of heritage resources, and lead times must be worked into the construction time frames. Table 55 gives guidelines for lead times on permitting.

Table 55: Lead times for permitting and mobilisation of heritage resources.

Action	Responsibility	Timeframe
Preparation for field monitoring and finalisation of contracts	The contractor and service provider	1 month
Application for permits to do necessary mitigation work	Service provider – Archaeologist and SAHRA	3 months
Documentation, excavation and archaeological report on the relevant site	Service provider – Archaeologist	3 months
Handling of chance finds – BGG/Human Remains	Service provider – Archaeologist and SAHRA	2 weeks
Relocation of BGG affected by the development	Service provider – Archaeologist, SAHRA, Local and Provincial Government	6 months

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Damage/destruction to known archaeological and heritage material (C1)	Construction	High -	Low +	Low +
Damage/destruction/disturbing of known graves (C2)	Construction	High -	Low +	Low +
Potential cumulative/confounding effects	Cumulative impacts on heritage are rated as being low in significance.			

Mitigation Measures

- **Implement a chance to find procedures in case where possible heritage finds are uncovered. Tentative 30m buffers should be placed on possible remote sensing and historical map markers, as supplied.**
- **Demarcate a 30 m buffer during construction and treat as no-go zones. Should a fence be erected, access to the BGG for interested and affected parties and next-of-kin must be allowed, and suitable measures for public access control must be put in place. An access protocol to manage visits by the next of kin must be included in the EMPr.**
    - **If direct impact is unavoidable and relocation is required, a grave relocation process (NHRA section 36) must be undertaken. This involves social consultation, public participation, and permits from SAHRA under the NHRA and the National Health Act (Act 61 of 2003) (NHA), as amended.**
- **Demarcate a 30 m buffer during construction and treat as no-go zones for sites graded as IIIC or higher. If conservation is not possible, mitigation must be undertaken under a NHRA section 34 permit from SAHRA, as well as a section 36 permit in the case of homesteads which hold the chance of containing graves. For mitigation of these sites, documentation by an architectural historian, which consists of drawing and photographing the structure and the layout, as well as recording any special characteristics identified during the recording, after which a destruction permit can be applied for, as discussed in the bullet point below.**
    - **This includes detailed documentation of the site layout and infrastructural characteristics, and archaeological geophysics and test excavations to investigate the possibility of infant burials for the homesteads which are assessed to hold the potential for graves, which will require a NHRA section 35 permit from SAHRA.**
    - **Destruction may proceed only on condition of the issuing of an appropriate permit from the relevant PHRA/SAHRA, which is supported by the mitigation report, or if the cultural heritage resource is to be retained in situ and not altered; an HMP in compliance with section 47(3) of the NHRA must be compiled by a heritage specialist/archaeologist and implemented.**
- **Demarcate a 30 m buffer during construction and treat as no-go zones for sites graded as IIIC or higher. As the 30 m buffer is a guideline, it may be reduced only if the site is clearly demarcated, strictly avoided, and such a reduction is approved by SAHRA. If conservation is not possible, mitigation must be undertaken under a NHRA section 35 permit from SAHRA.**
    - **This includes a sample surface collection for all types of archaeological material in the impacted areas.**
- **If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the ECO in charge of these developments must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carried out by a palaeontologist**

10 CONCLUSIONS AND RECOMMENDATIONS

This Basic Assessment Report has been prepared in accordance with the requirements of the National Environmental Management Act (NEMA, Act 107 of 1998) and the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended), to assess the potential environmental, social, and economic impacts associated with the proposed Tetra4 Cluster 2 seismic survey in the Free State Province. The purpose of the assessment was to determine whether the proposed activity can be undertaken in an environmentally responsible manner and whether it should be authorised, subject to appropriate conditions and mitigation measures.

The assessment has demonstrated that the proposed seismic survey is a temporary, non-invasive activity with a limited physical footprint. The nature of the survey, which utilises surface-based vibroseis technology, avoids the need for drilling and significantly reduces the risk of irreversible environmental damage. While the broader project area is large, the impacts associated with the activity are localised, short-term, and largely reversible, provided that the mitigation measures contained in this report and the Environmental Management Programme (EMPr) are strictly implemented.

A comprehensive review of the biophysical environment identified areas of high environmental sensitivity, including aquatic systems, biodiversity priority areas, heritage resources, and palaeontological features. Specialist studies were undertaken where required, informed by the National Web-Based Environmental Screening Tool and subsequent site sensitivity verification. These studies guided the refinement of the project layout, resulting in the avoidance of identified “no-go” areas and the adoption of flexible, micro-sited seismic line routing to minimise environmental disturbance.

Potential impacts on biodiversity, soils, water resources, heritage resources, and agricultural land use have been assessed and, with the incorporation of recommended mitigation measures, are anticipated to be of low to moderate significance. Importantly, no impacts of high or unacceptable significance were identified that cannot be effectively mitigated. The application of buffers, rehabilitation measures, timing restrictions, and strict operational controls is expected to ensure that environmental integrity is maintained throughout the life of the activity.

The social and socio-economic assessment indicates that the proposed survey will not result in significant negative impacts on local communities or landowners. Engagement with landowners and interested and affected parties (I&APs) forms a central component of the project approach, with commitments to advance notice, ongoing communication, and property-specific agreements prior to access. While employment opportunities are expected to be limited and largely temporary, the project has the potential to contribute positively to regional and national development objectives by supporting energy security and the responsible exploration of strategic resources.

Consideration of reasonable and feasible alternatives concluded that no viable location alternatives exist due to the geological and legal constraints of the exploration and production rights area. However, meaningful alternatives were identified and assessed in relation to layout, scheduling, and operational methodology. The preferred alternative—comprising flexible seismic line placement, avoidance of sensitive environmental and agricultural periods, and the use of non-invasive technology—represents the best practicable environmental option.

10.1 CONCLUSIONS FROM SPECIALIST STUDIES

10.1.1 TERRESTRIAL

The habitats within the PAOI for the proposed Tetra 4 Cluster 2 Project have been significantly altered by historical and ongoing land use, including agriculture, infrastructure development, mining, overgrazing, and widespread infestation by AIP species. As a result, most areas within the PAOI are in a degraded or modified state, reduced potential for supporting SCC. The remaining natural habitats are fragmented and subject to edge effects from roads, borrow pits, and other anthropogenic activities.

According to the Free State Biodiversity Plan (2015), the PAOI overlaps with areas classified as Critical Biodiversity Areas (CBA) 1 [Irreplaceable], CBA 2, Ecological Support Areas (ESA) 1 and ESA 2 (Figure 5-1). While

much of the PAOI is dominated by transformed [viz. agricultural activities and mining] and stands of AIPs and is therefore no longer broadly representative of the EN Vaal-Vet Sandy Grassland ecosystem, however some sections within the Disturbed Grassland and Degraded Grassland habitat units do retain characteristics representative of the bioregion. Importantly, the nature of the impacts associated with the proposed activities is expected to be temporary and not destructive. Given the already degraded and fragmented state of the habitats within the PAOI, and the limited potential for supporting SCC, the proposed activities are unlikely to result in significant additional loss of biodiversity or irreversible ecological damage. Despite this, consultation with regulating authorities is recommended for any development within CBAs and threatened ecosystems.

The completion of this Terrestrial Biodiversity assessment led to a dispute of the 'Very High' Terrestrial Biodiversity Theme Sensitivity as set out in the National Environmental Screening Tool. The PAOI is assigned predominantly 'Medium' [viz. Degraded grassland Sensitive Species and Water Resources] and 'Very Low' [viz. Degraded Grassland, Disturbed Grassland and Transformed] Terrestrial Theme Sensitivity. The Animal Species Theme Sensitivity has been disputed as high due to the presence of two SCC confirmed within the assessment area. The sensitivity for Plant Species Theme has been disputed as high, due to the presence of one SCC and seven protected flora species within the assessment are.

10.1.2 WETLANDS

During the site assessment, four natural HGM units were identified and delineated within the project area, comprising a channelled valley-bottom wetland (HGM 1), an unchannelled valley-bottom wetland (HGM 2), a seep wetland (HGM 3) and depression wetlands (HGM 4). In addition, associated drainage features were also identified within and adjacent to the proposed seismic survey footprint.

The National Environmental Screening Tool identified numerous wetlands and river areas as having Very High aquatic biodiversity sensitivity, with all remaining areas in the PAOI classified as Low sensitivity. Based on field and desktop verification, the specialist assessment assigned a High sensitivity to the river areas and High sensitivities to all wetlands. The drainage features were assessed as having Low sensitivity, reflecting its highly modified condition within intensively cultivated agricultural land and the influence of surrounding activities.

Given the nature of the proposed project (a temporary, vehicle-based seismic survey) and the application of the recommended avoidance and impact management measures, no direct impacts to wetlands are anticipated, provided that wetlands (HGM 1–3) are avoided during final routing and field operations. Depression wetlands (HGM 4) may be traversed only during the dry season and only where confirmed dry at the time of access, with re-routing required if wetness or saturation is observed. With these measures in place, the residual freshwater-related risks are expected to be low, with the primary residual risks relating to inadvertent wet-weather access and hydrocarbon leaks/spills, which are addressed through the prescribed compliance controls and monitoring.

10.1.3 AQUATICS

The baseline assessment established three main watercourses within the project area, namely the Sand River, Doring River, and Boschluispruit, and a single system outside the project boundary, the Palmietkuilspruit. Additionally, numerous ephemeral systems and wetlands occur throughout the project area. The ecological assessment of the watercourses indicated moderate to large modifications attributed to varying land use, namely agriculture, mining, and urban activities upstream of the project area on the Sand River (Virginia). The land use activities have cumulatively resulted in a moderate deterioration in water quality, flow, and instream habitat, and subsequently to the biotic communities within the systems. Given the findings of this assessment, no pristine or natural (class B) watercourse were observed, with the Doring River being classed as largely modified (class D), the Boschluispruit as largely modified (class D), and the Sand River as moderately modified (class C).

The water resources within the PAOI are poorly protected, and the ecosystems are critically endangered. Additionally, the Labeobarbus kimberleyensis (Largemouth Yellowfish) was expected within the Sand River and is the only species of conservational concern within the catchment and red listed as Near Threatened due to habitat fragmentation and water quality deterioration. The species was not collected during the survey, however, despite the absence of the species during the survey, the precautionary approach would assume the species to be within the project area and would likely be collected with increased sampling effort. The poorly

protected nature of the systems indicates that strict mitigation measures should be adhered to ensure no further deterioration of the watercourses should the project proceed.

The Sand, Doring and lower reaches of the Boschluispruit presented well defined riparian zones consisting of woody vegetation. The soils along the watercourses are highly susceptible to erosion and considered sensitive to any potential anthropogenic activities along these systems which could potentially compromise the ecological integrity of the watercourses. Therefore, a conservation buffer was calculated at 32 m.

10.1.4 PALAEONTOLGOY

The proposed Tetra4 3D Seismic Survey Project is underlain by Quaternary alluvium, Superficial sands, the dolerite of the Karoo Igneous Province as well as the Adelaide Subgroup of the Karoo Supergroup. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of Quaternary sediments is Moderate, that of the Karoo Igneous Suite is Zero, while that of the Adelaide Subgroup (Beaufort Group) is Very High (Almond and Pether, 2009; Almond et al., 2013, Groenewald et al 2014). Palaeontological Sensitivity generated by the Department of Forestry, Fisheries and the Environment National Environmental Web-Based (DFFE) Screening Tool indicates a Very High Palaeontological Sensitivity. Recent research has indicated that the Adelaide Subgroup is represented by the Balfour Formation.

No field-based palaeontological site investigation was undertaken, as the proposed Tetra4 3D seismic survey is non-invasive in nature and will not involve any excavation, drilling or ground penetration. The survey will be undertaken using vibroseis source vehicles and surface-deployed geophones to generate and record controlled seismic vibrations for the purpose of producing a three-dimensional subsurface geological model. All activities will be confined to surface operations along predefined survey lines.

Although the SAHRIS PalaeoMap indicates that the study area falls within a zone of Very High Palaeontological Sensitivity, the significance of potential impacts associated with the proposed survey is assessed as Very Low, owing to the non-invasive nature of the activities. As no vegetation clearance or subsurface disturbance will occur, the proposed survey is not expected to result in any direct impacts on palaeontological heritage resources.

10.1.5 HERITAGE

A standalone Palaeontological Desktop Assessment was conducted by PGS Heritage (Pty) Ltd; 942HIA-002.

During the study, a total of 22 heritage sites and 28 features were identified. These consist of six historical homesteads; five metal objects; 12 recent structures) , one ceramic surface scatter; and one grave.

Of the six historical homesteads/structures identified on site, all were predominantly foundation remnants or had >5% ex situ. All were graded as NCW with zero-low local significance.

12 recent structures were identified on site, all were predominantly foundation remnants or had >5% ex situ all of which were graded as NCW with zero local significance.

There were five metal objects, predominantly industrial machinery remnants and oil/water drums (T_VklP_1, T_VklP_4[a], T_VklP_6, T_VklP_7, and T_VklP_10), graded NCW with low local significance, and one ceramic surface scatter (T_BD_1) of famille-bleu polychrome ceramic sherds, graded NCW with low local significance.

A single illegibly marked grave was identified (T_BV_1), and graded as Grade IIIA, with high significance. It should be noted that the landowner advised of another grave within the vicinity, but was not forthcoming with a precise bearing, and the receiving environment was incredibly overgrown and impassable.

10.2 SENSITIVITY MAP

A comprehensive assessment of all sensitivity factors and their corresponding levels was undertaken. The results were synthesized into two maps: a maximum sensitivity map and a sensitivity intensity map. The former delineates areas exhibiting the highest sensitivity based on a single dominant factor, such as agriculture or terrestrial ecology. Conversely, the sensitivity intensity map represents an aggregate of all sensitivity factors, providing a holistic overview of environmental vulnerability. It is important to note that the site sensitivity map

presented herein differs from the mapping developed for the Tetra4 Phase 2 EIA. This variation is due to the distinct nature of the proposed activities assessed within this Basic Assessment (BA). The sensitivity ratings applied in this report are specifically aligned to the anticipated impacts associated with the current project scope.

The high sensitivities observed in Figure 70 are primarily attributed to the high aquatic biodiversity and wetland sensitivity within the study area. Furthermore, the terrestrial specialists have designated the degraded Grassland Sensitive species habitat and associated water resources as a no-go area. Concurrently, the aquatics specialists have classified the Sibanye Beatrix West mine tailings and operational footprint as a separate no-go area.

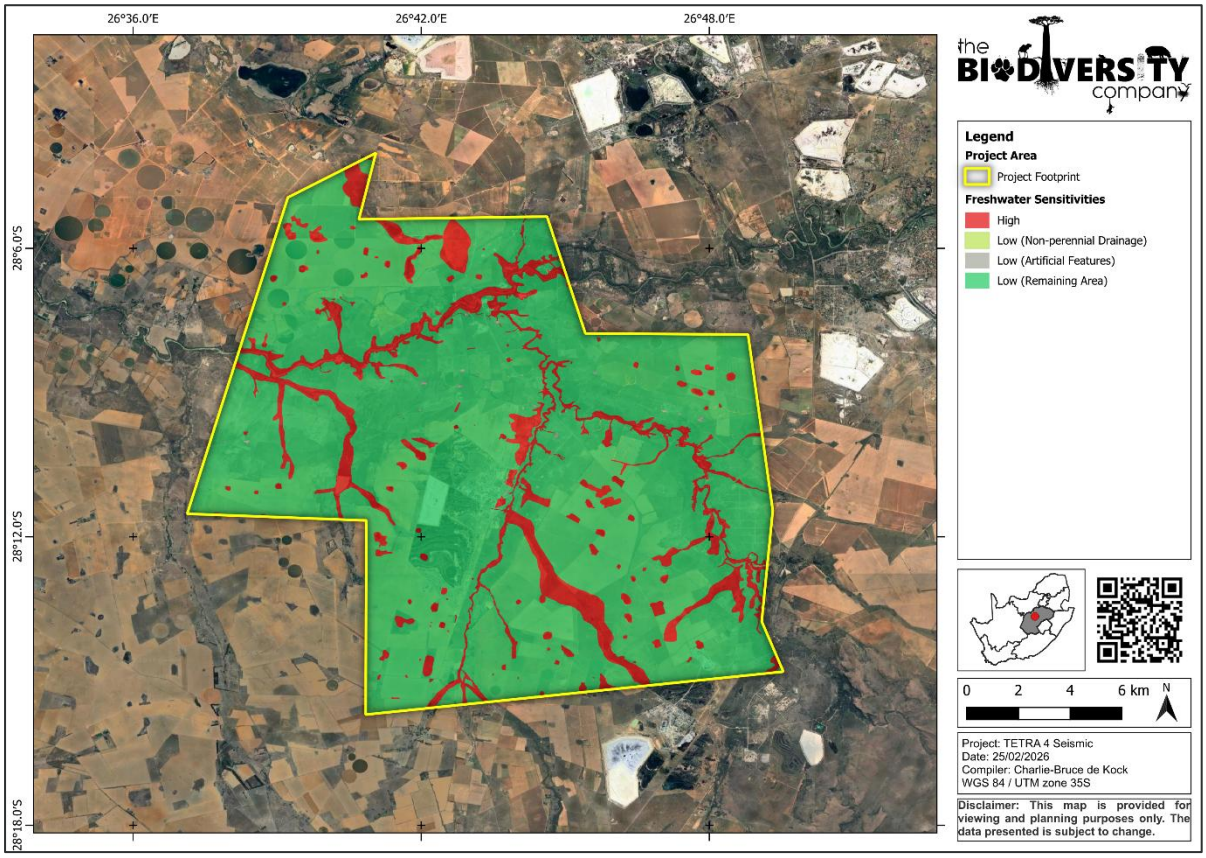


Figure 70: Wetland Sensitivity map.

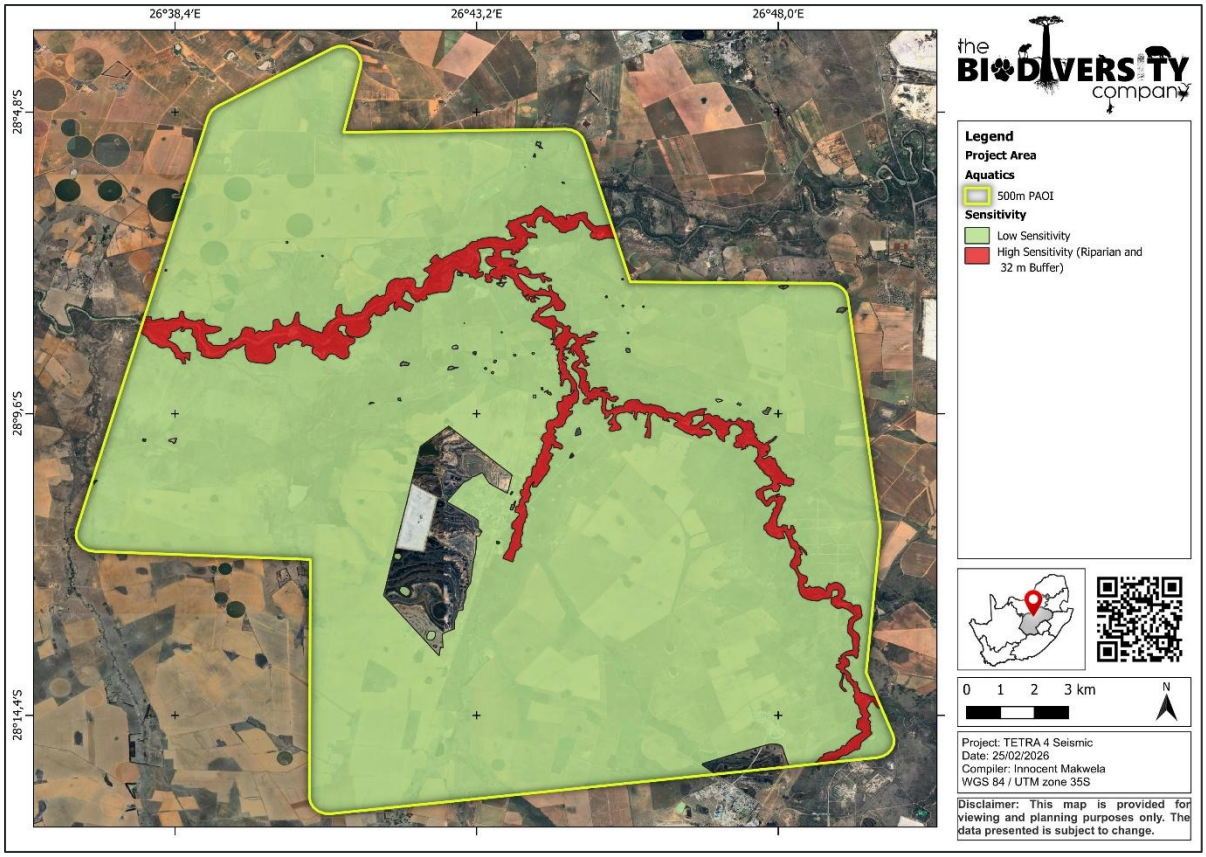


Figure 71: Aquatics sensitivity map.

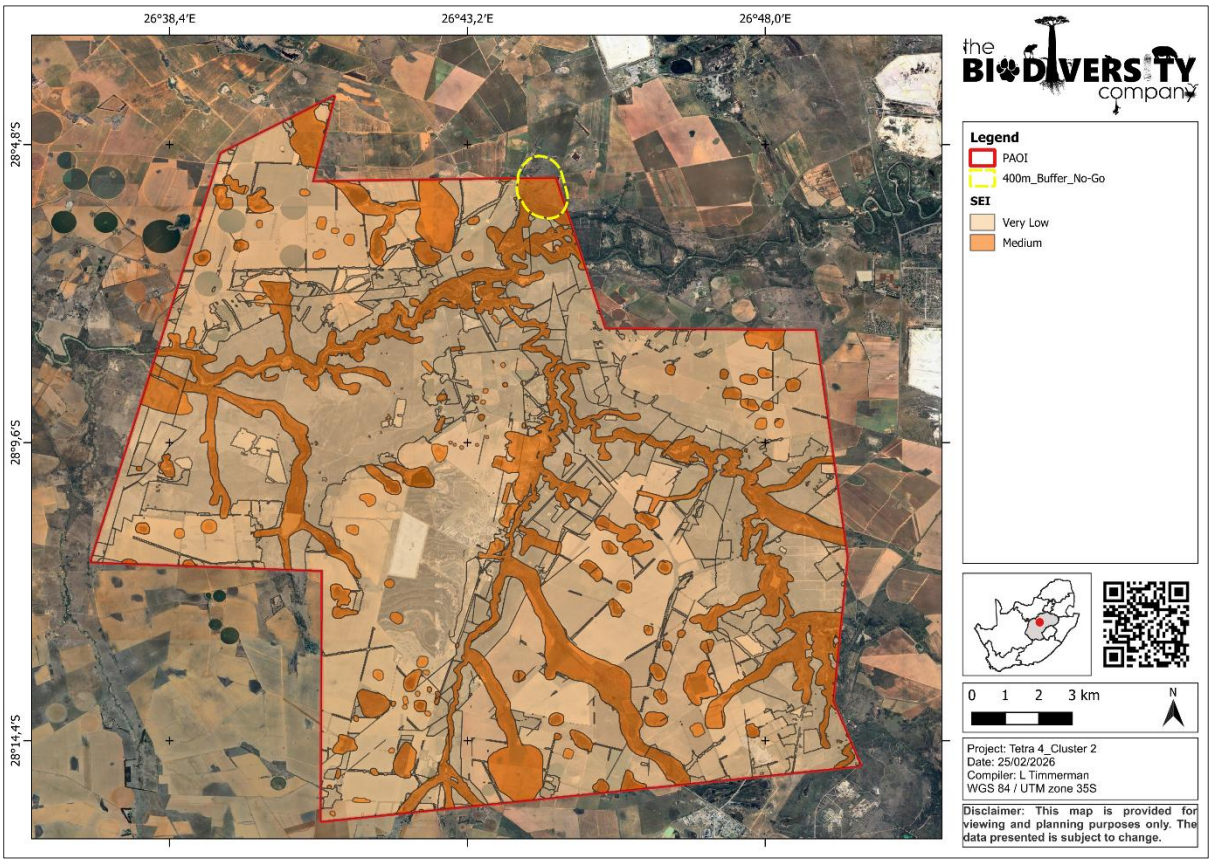
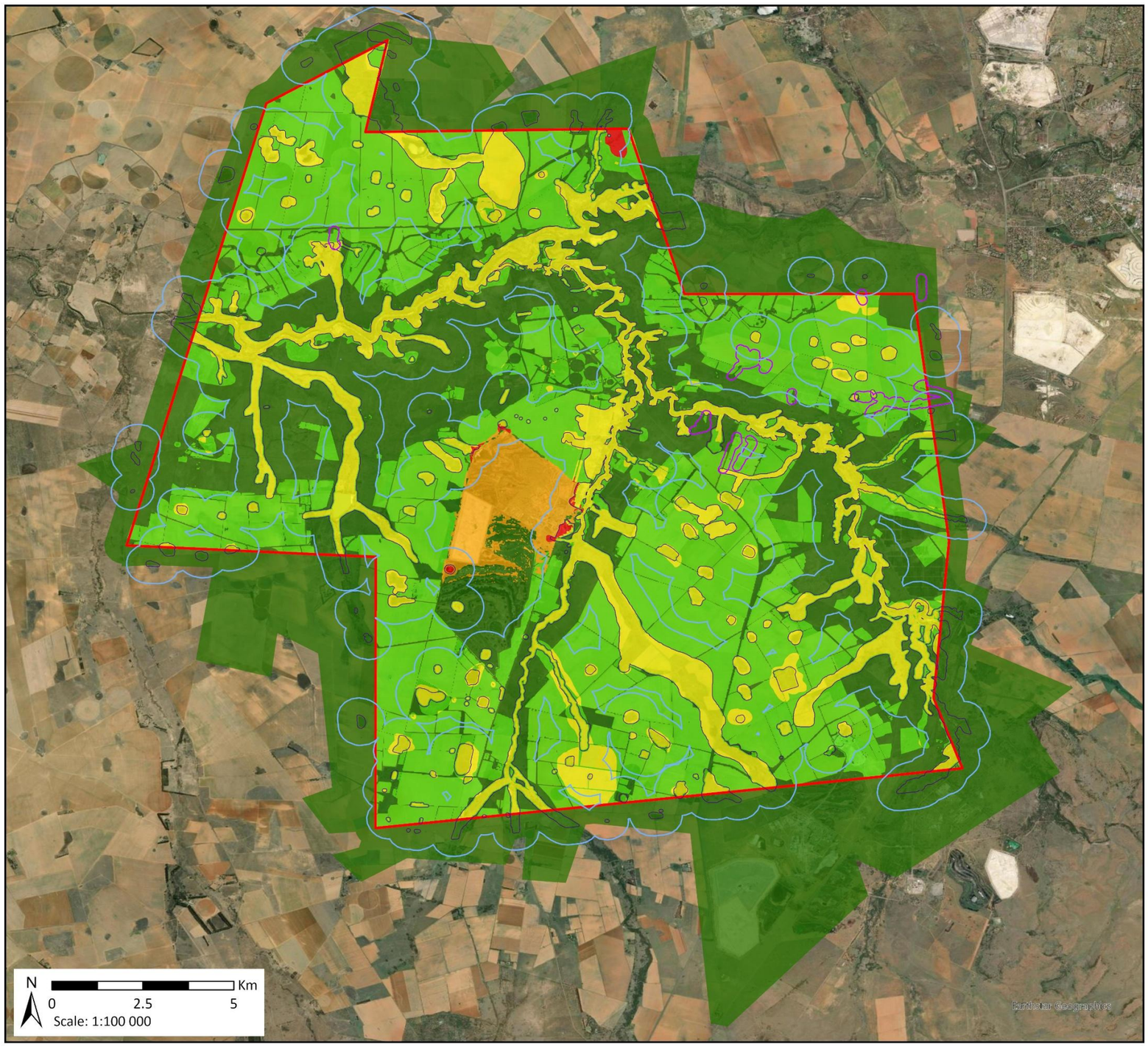


Figure 72: Terrestrial Sensitivity map.



Sensitivity Intensity Map

1595 Tetra4 Seismic EA Amendment

Legend

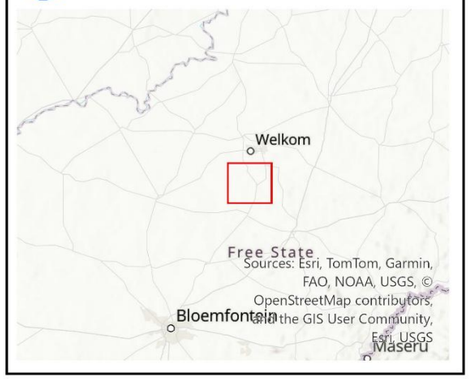
Cluster 2 Boundary
Study Area

Sensitivity Intensity

0.00 - 3.00
3.01 - 5.00
5.01 - 10.00
10.01 - 102.00
102.01 - 107.00

Freshwater Buffers

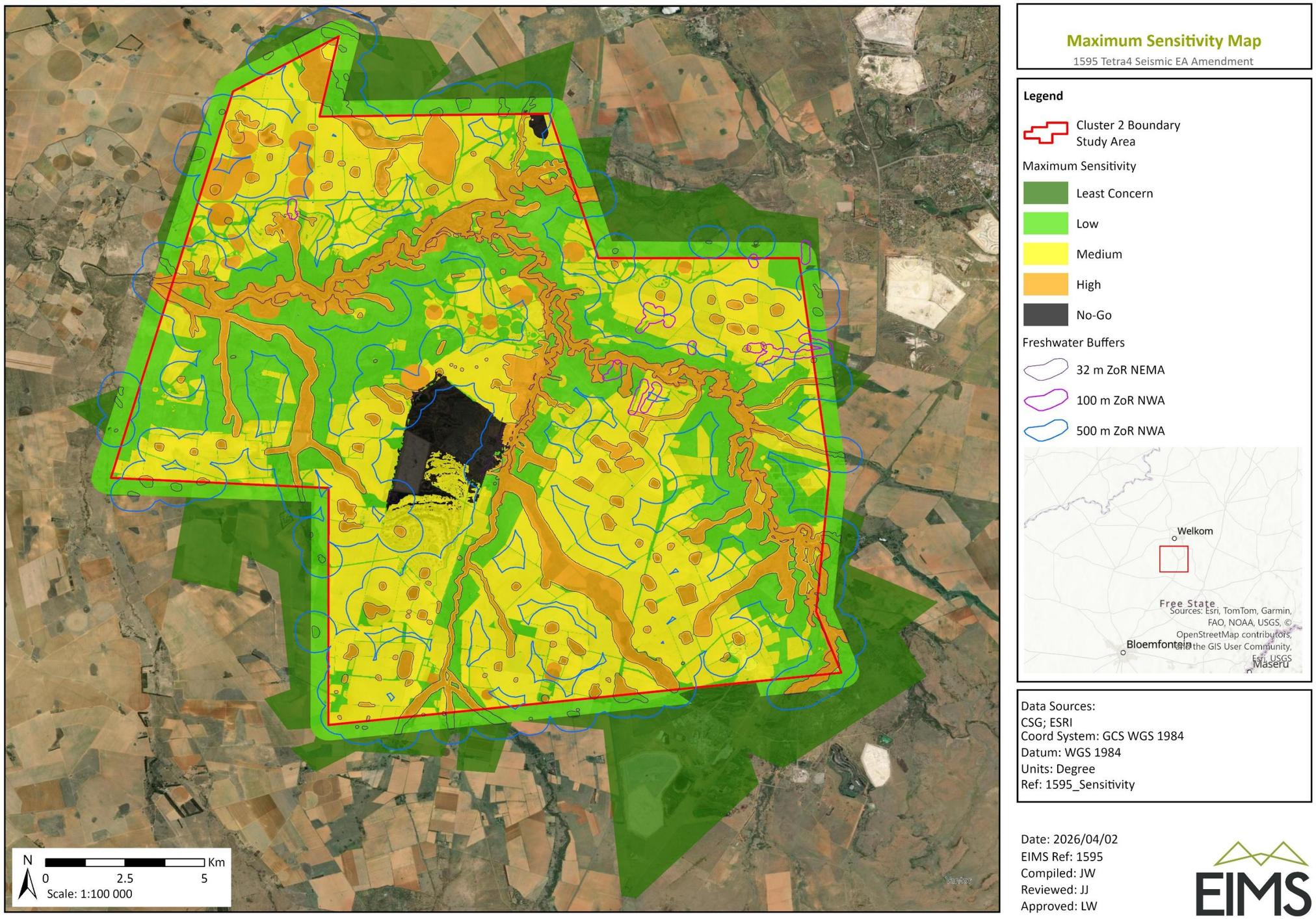
32 m ZoR NEMA
100 m ZoR NWA
500 m ZoR NWA



Data Sources:
CSG; ESRI
Coord System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
Ref: 1595_Sensitivity

Date: 2026/04/02
EIMS Ref: 1595
Compiled: JW
Reviewed: JJ
Approved: LW

Figure 73: Sensitivity intensity map for proposed project area.



Maximum Sensitivity Map

1595 Tetra4 Seismic EA Amendment

Legend

Cluster 2 Boundary
Study Area

Maximum Sensitivity

Least Concern
Low
Medium
High
No-Go

Freshwater Buffers

32 m ZoR NEMA
100 m ZoR NWA
500 m ZoR NWA

Data Sources:
CSG; ESRI
Coord System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
Ref: 1595_Sensitivity

Date: 2026/04/02
EIMS Ref: 1595
Compiled: JW
Reviewed: JJ
Approved: LW

Figure 74: Maximum sensitivity map for proposed project area.

10.3 ASSESSMENT OF ALTERNATIVES

In accordance with Section 24 of the National Environmental Management Act (NEMA) and the EIA Regulations (GN R982 of 2014, as amended), this process identified and evaluated feasible and reasonable alternatives. The evaluation was driven by the project's core objectives: securing local energy reserves (including LNG as a transition fuel and helium as a strategic resource) and stimulating regional economic growth, while minimizing environmental and social impacts.

Due to the highly specialized nature of the proposed development, discrete alternatives are limited to the Preferred Alternative and the No-Go Alternative, with environmental optimizations handled through incremental layout and scheduling adjustments.

No feasible macro-location alternatives exist. The survey area is fundamentally dictated by the legal boundaries of the granted Exploration Right and the specific subsurface geological targets. Moving the survey outside this geographical area would fail to meet the project’s primary objective.

The proposed activity—a terrestrial seismic survey utilizing vibroseis trucks—is the preferred exploration method. It allows for the generation of a comprehensive, high-resolution geological model using temporary, surface-level acoustic technology. This is vastly preferred over physical exploration drilling, as it eliminates vegetation clearing, deep earthworks, and the risk of groundwater interception.

Given the extensive footprint in the Free State, scheduling alternatives are critical. Operations will be strictly phased to avoid sensitive temporal windows. This includes scheduling activities outside of critical ecological periods (wildlife migration and breeding) and avoiding peak agricultural seasons (planting and harvesting) to prevent disruptions to the local agricultural economy.

While the macro-location is fixed, the internal layout is highly flexible. The project will deviate from rigid, mathematically straight grid lines to prioritize biophysical and socio-economic sensitivities. All seismic lines and vehicle access paths will be actively micro-sited to utilize existing farm roads and firebreaks, ensuring operations completely avoid "no-go" areas such as wetlands, drainage lines, heritage sites, and critical farming infrastructure.

The "do nothing" alternative maintains the current status quo, resulting in no immediate impacts on agricultural operations or local ecology. However, this option results in the loss of geological data and future regional economic development. Furthermore, without the macro-level data provided by a non-invasive seismic survey, the applicant would be forced to revert to untargeted exploration drilling to locate gas reserves, ultimately resulting in a much larger, unnecessary environmental footprint.

The Preferred Alternative represents an integrated, low-impact approach. It restricts the operation to the legally bound Exploration Right area while employing a highly flexible, micro-sited internal layout to safeguard all identified "no-go" sensitivities. By strategically scheduling the survey outside of active agricultural and ecological windows, and utilizing non-invasive vibroseis technology, this alternative successfully acquires essential subsurface data while strictly minimizing the spatial and temporal footprint on the receiving environment.

10.4 ENVIRONMENTAL IMPACT STATEMENT

The findings of the assessment and associated specialist studies conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding, provided that the recommended mitigation and management measures are implemented. All identified impacts are expected to have low or moderate to low significance after mitigation is applied. Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the exploration activities, the findings of the specialist studies, and the understanding of the significance level of potential environmental impacts, it is the opinion of the BA project team and the EAP that the significance levels of the majority of identified negative impacts can generally be reduced to an acceptable level by implementing the recommended mitigation measures and the project should be authorised.

10.5 RECOMMENDATIONS FOR INCLUSION IN ENVIRONMENTAL AUTHORISATION

This section contains recommendations from the EAP and various specialists for inclusion in the EA.

10.5.1 EAP

This section contains recommendations from the EAP and various specialists for inclusion in the EA. The following recommendations should be included:

- Prior to site mobilisation, a comprehensive hydrocensus must be conducted across the entire survey grid. This involves consulting with all landowners to locate and assess the baseline status (depth, yield, and equipment) of all active, inactive, and abandoned boreholes, springs, and wells.
- A buffer zone of at least 100 m to 150 m (depending on the specific vibroseis energy output and local geological attenuation factors) must be delineated around all identified boreholes and water points. Vibroseis source points must be offset if they fall within this radius. Support vehicles may traverse these zones, but active vibration should be avoided.
- Where survey lines must necessarily pass near critical water infrastructure or sensitive farm buildings, peak particle velocity (PPV) seismographs should be temporarily deployed to ensure ground vibration limits do not exceed safe infrastructural thresholds.
- Written access agreements must be negotiated with every affected landowner prior to mobilisation. The survey schedule must avoid actively harvested or planted fields where possible. Ideally the seismic activities should take place during fallow seasons, unless an agreement is in place between the landowners and the applicant. Landowners must receive a minimum of 5 business days' notice before the fleet enters their specific property boundaries.
- Active vibroseis operations must be completely avoided within ecologically sensitive habitats, such as seasonal pans and wetlands, during the breeding seasons to prevent acoustic stress and reproductive disruption to local fauna
- To prevent sleep disturbance and align with natural diurnal faunal activity patterns, all active vibroseis sweeping and heavy vehicle movement must be strictly limited to daylight hours (e.g., 06:00 to 18:00).

10.5.2 HERITAGE

During the construction phase, it is important to recognise any significant material being unearthed, making the correct judgment on which actions should be taken. It is recommended that the following Chance Finds Procedure (CFP) be implemented:

- A heritage practitioner/archaeologist should be appointed to develop a heritage induction program and conduct training for the Environmental Control Officer (ECO) as well as team leaders in the identification of heritage resources and artefacts during the implementation of the Environmental Management Program (EMPr).
- An appropriately qualified heritage practitioner/archaeologist must be identified to be called upon in the event that any possible heritage resources or artefacts are identified.
- Should an archaeological site or cultural material be discovered during construction (or operation), the area should be demarcated, and construction activities halted.
- The qualified heritage practitioner/archaeologist will then need to come out to the site and evaluate the extent and importance of the heritage resources and make the necessary recommendations for mitigating the find and the impact on the heritage resource.

- The contractor therefore should have a contingency plan so that operations could move elsewhere temporarily while the materials and data are recovered.
- Construction can commence as soon as the site has been cleared and signed off by the heritage practitioner/archaeologist.

10.5.3 PALAEONTOLOGY

Should any fossil material be encountered during any phase of the project, whether exposed at surface or during unforeseen ground-disturbing activities, the Chance Find Protocol must be implemented immediately by the Environmental Control Officer (ECO) or the responsible site manager. All fossil discoveries must be protected in situ and reported to the South African Heritage Resources Agency (SAHRA) to ensure that appropriate recording and, where necessary, collection can be undertaken by a qualified palaeontologist.

10.5.4 TERRESTRIAL BIODIVERSITY

- All mitigation and management measures outlined in this and other specialist reports must be strictly implemented;
- Complete avoidance of all areas classified as Medium Sensitivity Ecological Importance within the Cluster 2 PAOI; and
- An updated layout of the PAOI must be delineated to clearly demonstrate the avoidance of Medium SEI habitat.

Free State Biodiversity Spatial Plan	Habitat unit	Condition	SEI	Specialist Opinion	Impact Statement
CBA1 & 2	Degraded Grassland	Degraded	Very Low	Drivable	Acceptable impacts
	Degraded Grassland (Sensitive Species)	Degraded	Medium	No-Go	Acceptable impacts
	Disturbed Grassland	Disturbed	Very Low	Drivable	Acceptable impacts
	Transformed	Modified	Very Low	Drivable	Acceptable impacts
	Water Resources and Buffers	Disturbed	Medium	Refer to accompanying Freshwater Assessment (TBC, 2026)	Refer to accompanying Freshwater Assessment (TBC, 2026)

10.5.5 AQUATIC BIODIVERSITY

All identified riparian zones must be demarcated as no-go areas before site establishment. The project prioritizes route planning that bypasses these features entirely; where crossing is unavoidable, only pre-approved, existing access points may be used.

To prevent habitat fragmentation and erosion, vehicle movement is strictly confined to approved transect lines and existing tracks. The measures mandate minimal clearing and progressive rehabilitation of any disturbed ground. Stringent controls are required for hazardous materials. This includes using bunded storage for

hydrocarbons and chemicals, and ensuring all refuelling occurs in designated areas far from watercourses to ensure zero spills reach the aquatic environment..

11 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations relating to this assessment should be considered in evaluating and decision-making on this assessment:

- Unless specifically noted, the environmental attributes for the receiving environment have been obtained from best available spatial and scientific data sources. Whilst reasonable effort has been taken to obtain the most recent and relevant data, there may be gaps in baseline data, leading to uncertainties in impact predictions. Where uncertainty exists, efforts are made to indicate this in the assessment.
- This study is based on activity information provided by the applicant (including engineering designs, specifications, services reports, etc). The accuracy of this information has not been verified, and it is assumed that no significant changes or deviations to the final designs will occur. Should such occur the significance of the potential impacts may require reassessment and where relevant formal amendment processes.
- The information presented in this report is based on the information available at the time of compilation of the report.
- Whilst reasonable effort has been made to identify all potential environmental impacts, some impacts may not be reasonably foreseeable or may emerge only after project implementation.
- In determining the significance of impacts, with mitigation, it is assumed that mitigation measures proposed in the report are correctly and effectively implemented and managed throughout the life of the project.

The remaining sub-sections present the assumptions and limitations applicable to the respective specialist assessments.

11.1 AQUATICS, WETLAND AND TERRESTRIAL ASSESSMENTS

The following limitations should be noted for the Aquatics assessment:

- has been assumed that the spatial files provided to the specialist are accurate;
- The assessment area was based on the spatial file provided by the client and any alterations to the development area may affect the results;
- Standard rapid assessment protocols were applied during the study, and therefore a low confidence is provided in the assessment of the biotic community and a snapshot of water quality conditions. As the survey protocols are rapid, it is likely that the biotic community is underestimated, and that additional studies would yield additional species. Despite the rapid nature of the survey, the results do provide informative data of the general biotic community;
- Flooding conditions within the Sand River reduced the efficacy of sampling instream habitat for aquatic biota during the 2022 survey. Additionally, water quality results do not reflect stable conditions within the region; and
- Access to several sites was limited during the survey, and therefore no sampling was conducted at sites T2, TS2, and limited access to S3 during both 2022 and 2026 surveys. Additionally, several ephemeral systems were dry. These sites remain critical to ecosystem services and are regarded as highly sensitive.
- The seasonality of the site survey is not considered to be a limiting factor for this project.

The following assumptions and limitations are applicable for the Wetland assessment:

- It has been assumed that the spatial files provided to the specialist are accurate;
- Apart from the infrastructure components as indicated in the layout map, no other relevant spatial information in terms of the structure design was provided in relation to the proposed development at the time report preparation;
- Representative sampling within the assessment area was conducted and by its nature would result in some areas of the assessment area not being covered on foot. However, the results derived were sufficient to derive a meaningful baseline of the study area in the context of freshwater ecosystems;
- Delineations for areas within a 500 m distance from the site were undertaken from a desktop perspective with limited field verification for accessible areas;
- The seasonality of the surveys is not considered to be a limiting factor with regard to the identification and delineation of wetlands, the only limitation in this regard would be the identification of certain plant species. The results of the assessment are considered conclusive in the opinion of the specialist;
- Only natural features were considered for the ecological components of this assessment; and
- The GPS used for water resource delineations is accurate to within five metres. Therefore, the wetland delineation plotted digitally may be offset by a maximum of five metres to either side.

The following assumptions and limitations are applicable for the Terrestrial assessment:

- It is assumed that all information received from the client/EAP is accurate;
- All datasets accessed and utilised for this assessment are considered to be representative of the most recent and suitable data for the intended purposes;
- Insects and invertebrates do not form part of the scope of work for this assessment;
- The assessment area (PAOI) was based on the footprint areas as provided by the client/EAP, and any alterations to the area and/or missing Geographic Information System (GIS) information pertaining to the assessment area would have affected the area surveyed and hence the results of this assessment;
- The project description was based on information provided by the client/EAP, and any alterations to the area and/or missing data pertaining to the development would have affected the area surveyed and hence the results of this assessment;
- Different portions of the PAOI were not assessed due to access limitations;
- Whilst every effort was made to cover as much of the PAOI as possible, representative sampling was completed. Consequently, it is possible that some fauna and flora species present within the PAOI may have not been recorded during the field survey;
- The Global Positioning System (GPS) used in the assessment has an accuracy of 5 m and consequently any spatial features may be offset by up to 5 m;
- The Compliance Statement provided in this report is strictly contingent upon the complete avoidance of all areas classified as Medium (viz. Degraded Grassland Sensitive Species and Water Resources and Buffers) Sensitivity Ecological Importance (SEI) within the Cluster 2 PAOI. This statement is based solely on areas designated as Very Low SEI, specifically Degraded Grassland, Disturbed Grassland, and Transformed habitats; and
- It is essential that an updated layout of the PAOI be delineated to clearly demonstrate the avoidance of Medium SEI habitats. The avoidance of Disturbed Grassland Sensitive Species, Water Resources and Buffers is a prerequisite for this Compliance Statement to remain valid and;

- All delineations presented in this report are based on the previous assessment conducted in May 2022 by TBC. For any information pertaining to water resources and aquatic systems, please refer to the accompanying reports (TBC, 2026)

11.2 HERITAGE AND PALAEONTOLOGY ASSESSMENTS

The following assumptions and limitations are applicable for the Heritage assessment:

Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, amongst others the subterranean nature of some archaeological sites and existing vegetation cover. However, most of the study area was accessible for the fieldwork survey.

Fieldwork was also focussed on areas that were not previously disturbed by farming/construction/mining, thus concentrating on areas with the highest potential to yield indications of the possible presence of heritage resources.

Therefore, should any heritage features and/or objects be located or observed outside the identified heritage sensitive areas during construction activities, a heritage specialist must be contacted immediately. Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time as the heritage specialist has been able to make an assessment of the significance of the site (or material) in question. This also applies to Burial Grounds and Graves (BGG). If any BGG are located or observed during the course of the development, the procedures and requirements pertaining to BGG will apply as set out below.

The following assumptions and limitations are applicable for the Palaeontology assessment:

Geological maps primarily focus on the lithology and structural geology of an area, and their accompanying sheet explanations were not intended to emphasise palaeontological heritage. Many remote regions of South Africa remain unexplored by palaeontologists, with available data often derived solely from aerial imagery. Furthermore, fossil locality and geological data stored in museum and university collections are frequently outdated or were historically recorded with limited accuracy.

To supplement these gaps, comparable Assemblage Zones and geological formations from better-studied regions are often referenced to infer the potential for fossil presence in previously undocumented areas. In desktop studies, it is typically assumed that fossil heritage may be present where similar stratigraphy is exposed. However, a field-based assessment is essential to validate and refine these assumptions, thereby enhancing the accuracy of the palaeontological sensitivity rating.

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- 1: 50 000 scale topographic maps.
- Palaeosensitivity map on SAHRIS (South African Heritage Resources Information System) website.
- DFFE Screening Tool of the study area
- A Google Earth kmz files and background information on the proposed development was supplied by PGS Heritage as received from the developer.
- 1:250 000 Winburg 2826 Geological Map (Council for Geosciences, Pretoria).
- Palaeontological Impact Assessments in the same area are studied
- No site investigation was conducted for the Project; however, a site investigation is recommended in this report.

12 AFFIRMATION REGARDING CORRECTNESS OF INFORMATION

I, John Von Mayer, declare that:

- *I act as the independent environmental practitioner in this application*
- *I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;*
- *I declare that there are no circumstances that may compromise my objectivity in performing such work;*
- *I have expertise in conducting environmental impact assessments, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;*
- *I will comply with the Act, regulations and all other applicable legislation;*
- *I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;*
- *I have no, and will not engage in, conflicting interests in the undertaking of the activity;*
- *I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;*
- *I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;*
- *I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;*
- *I will keep a register of all interested and affected parties that participated in a public participation process; and I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not all the particulars furnished by me in this form are true and correct;*
- *I will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and*
- *I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.*

I, Jessica Jordaan, declare that:

- *I act as the independent environmental practitioner in this application*
- *I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;*
- *I declare that there are no circumstances that may compromise my objectivity in performing such work;*

- *I have expertise in conducting environmental impact assessments, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;*
- *I will comply with the Act, regulations and all other applicable legislation;*
- *I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;*
- *I have no, and will not engage in, conflicting interests in the undertaking of the activity;*
- *I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;*
- *I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;*
- *I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;*
- *I will keep a register of all interested and affected parties that participated in a public participation process; and I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not all the particulars furnished by me in this form are true and correct;*
- *I will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and*
- *I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.*

Disclosure of Vested Interest (delete whichever is not applicable)

I, John Von Mayer, do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014.

Signature of the EAP

Environmental Impact Management Services (Pty) Ltd

Name of company:

2026/06/05

Date:

I, Jessica Jordaan, do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014.

Signature of the EAP

Environmental Impact Management Services (Pty) Ltd

Name of company:

2026/06/05

Date:

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Appendix A: EAP CV

Appendix B: Screening Tool Report and SSVR

Appendix C: EA Application Form

Appendix F: Impact Assessment Matrix

Appendix H: Maps